Library

Southwest FISHERIES SCIENCE CENTER

HONOLULU LA JOLLA MONTEREY TIBURON

REPORT OF ACTIVITIES May-June 1992

ANTARCTIC ECOSYSTEM RESEARCH GROUP **Page**

AMLR Group Produces Publications 1

COASTAL FISHERIES RESOURCES DIVISION

Researchers Study Growth Rates of Dover Sole Larvae 2

MARINE MAMMAL DIVISION

Incidental Take of Small Cetaceans Observed in the Eastern Tropical Pacific 6

HONOLULU LABORATORY

Starving Hawaiian Monk Seals Rescued from French Frigate Shoals 10

PACIFIC FISHERIES ENVIRONMENTAL GROUP

Bakun Leaves Laboratory for FAO 14

PELAGIC FISHERIES RESOURCES DIVISION

SWFSC Hosts Western Pacific Yellowfin Tuna Research Group Meeting 15

TIBURON LABORATORY

Transformation of Nearshore Habitat Continues with Increases in Purple Sea Urchin 17

INFORMATION TECHNOLOGY SERVICES

AIMS Project Progresses 21

PUBLICATIONS 23

LIBRARY

NOV 27 199?

National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

SOUTHWEST FISHERIES SCIENCE CENTER

CENTER ADMINISTRATION- La Jolla, California

Science and Research Director, SWR ..... *Izadore Barrett*
Deputy Director ..... *Richard A. Neal*
Planning Officer ..... *David J. Mackett*
Information Technology Services ..... *Dorothy Roll*
Executive Officer ..... *Benjamin F. Remington*

LABORATORIES & DIVISIONS

Antarctic Ecosystem Research Group, Chief ..... *Rennie Holt*
La Jolla, California
Coastal Fisheries Resources Division, Chief ..... *John R. Hunter*
La Jolla, California
Marine Mammal Division, Chief ..... *Douglas P. DeMaster*
La Jolla, California
Honolulu Laboratory, Director ..... *George W. Boehlert*
Honolulu, Hawaii
Pacific Fisheries Environmental Group, Chief ..... *Andrew Bakun*
Monterey, California
Pelagic Fisheries Resources Division, Chief ..... *Gary T. Sakagawa*
La Jolla, California
Tiburon Laboratory, Director ..... *Alec MacCall*
Tiburon, California

The Report of Activities of the Southwest Fisheries Science Center is compiled at La Jolla from material submitted by the Center's staff. To change the delivery address of the Report of Activities, or to cancel your subscription, please notify Connie Blair, at P.O. Box 271, La Jolla, CA 92038-0271. Telephone: (619) 546-7063.

ANTARCTIC ECOSYSTEM RESEARCH GROUP

La Jolla, California

AMLR Group Produces Publications

During May and June, the U.S. Antarctic Marine Living Resources (AMLR) program group (managed by the Antarctic Ecosystem Research Group [AERG]) put most of its efforts into analyzing data collected during past field seasons and reporting their findings in a variety of different publications. Many of the published papers have been completed as part of the AMLR program's participation in the upcoming annual meetings of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), in particular the Working Groups on Krill (WG-Krill) and the CCAMLR Ecosystem Monitoring Program (WG-CEMP).

Krill Stock Assessment Program Task Leader Roger Hewitt and Ocean Acoustic Engineer David Demer, of the AERG, have authored a paper that will be presented at the WG-Krill and WG-CEMP meetings. It is entitled "Distribution and abundance of krill in the vicinity of Elephant Island in the 1992 austral summer," and it describes data collected during four acoustic surveys conducted from mid-January to mid-March 1992 during the AMLR research cruise aboard the NOAA Ship *Surveyor*. Estimates of krill biomass in the study area around Elephant Island are also presented. The paper indicates that, in general, krill biomass in the study area decreased as the season progressed, from 2.2 million metric tons (t) in late January to 1.1 million t six weeks later.

A second paper, "Calibration of an acoustic echo integration system in a deep tank, with system gain comparisons over standard sphere material, water temperature, and time," was authored by Demer and Hewitt and will be presented at the WG-Krill meeting. The paper outlines the theory and procedures for calibrating an echo integration acoustic system with a standard sphere and presents the results of an extensive calibration of a Simrad EK500 scientific echo sounder with a 120 kHz split-beam transducer in a refrigerated 10-m deep tank. Calibration parameters were studied in relation to sphere material, water temperature, transmitted pulse length, target depth, and time of calibration.

Fishery Biologist George Watters, AERG, and Hewitt have authored a paper for the WG-Krill meeting, and it is entitled "Alternative methods for determining subarea or local-area catch limits for krill in statistical area 48." The paper is in response to a conservation measure adopted by CCAMLR in 1991 which set a 1.5-million t precautionary catch limit on krill, *Euphausia superba*, in statistical area 48 (the south Atlantic sector). The measure came about in response to concerns regarding the adverse impact of the krill fishery on krill predators reproducing in these areas. In addition to setting a catch limit, the conservation measure also required that CCAMLR's scientific committee provide advice on how the 1.5-million t limit could be allocated between subareas or local areas if the total catch in subareas 48.1 (Antarctic Peninsula), 48.2 (South Orkney Islands), and 48.3 (South Georgia) exceeds 620,000 t in any fishing season.

William Fraser (Old Dominion University), a principal investigator funded by the AMLR program, will present a paper at the WG-CEMP meeting; the paper is entitled "Report on the assessment of incidental mortality, Palmer Station, 1991-1992," and it summarizes data on the incidence of marine debris, as well entanglement mortality, in the Palmer Station area during the 1991/92 season. Research at Palmer Station, along with studies conducted at Seal Island, make up the land-based component of the AMLR program's field research. Four cases of entanglement, involving embedded long-line hooks and nylon line in adult giant fulmars, *Macronectes giganteus*, were documented. The finding is important because this is the first known incidence of this type of entanglement in the Palmer Station area, and it indicates that a long-line fishery is now operating within the foraging range of this species.

Biological Technician Jane Rosenberg, AERG, and Hewitt have compiled and edited the 1991/92 AMLR field season report. The report includes a summary written by Hewitt and Rosenberg of research conducted during the 1992 cruise in the waters surrounding Elephant Island and at field camps on Seal Island and at Palmer Station. In addition, detailed summaries written by the AMLR program's principal investigators are included in the report. The field season report fulfills a variety of post-cruise obligations and will also be presented at the WG-CEMP meeting.

The National Marine Mammal Laboratory Antarctic Ecosystem Program, a major component of the AMLR program, has produced three papers for consideration at the WG-CEMP meeting. Peter Boveng and John Bengtson have written the first paper, entitled "Synthesis and evaluation of data for estimating prey requirements of Antarctic fur seals in the Antarctic Peninsula integrated study region," which represents completion of a task assigned to the United States by the 1991 WG-CEMP to compile data on fur seals for estimating prey requirements in the Antarctic Peninsula integrated study region. The paper describes data collected on population size, duration and timing of breeding events, body mass, diet, and energy content of food. A second paper, "Antarctic Peninsula integrated study region penguin bioenergetic model input parameters," was written by Don Croll and John Jansen in response to a request from the 1991 WG-CEMP for investigators to review and submit input parameters that may be used in modeling the prey requirements of krill predators in the CEMP-integrated study regions. Croll has produced the third paper, entitled "Metabolic rates, foraging ranges, and assimilation efficiencies of penguins: a review," for the WG-CEMP. This paper also addresses WG-CEMP's interest in prey requirements.

Valerie Loeb (Moss Landing Marine Laboratories), a principal investigator in the AMLR program, and Volker Siegel (Sea Fisheries Research Institute) have written a paper for the WG-Krill meeting; it is entitled "Variability of krill stock composition and distribution in the vicinity of Elephant Island during AMLR investigations 1988-92." In the paper, the authors report results which indicate strong recruitment from krill spawning in 1987/88 and 1990/91 and poor recruitment from spawning in 1988/89 and 1989/90. In addition, overall distribution patterns during each year indicate that older age classes were associated with Southern ocean/Drake Passage waters while younger classes were associated with waters closer to the Elephant Island area.

Finally, the AMLR program group has submitted a series of papers to the *Antarctic Journal of the United States* for the 1992 review issue. Rosenberg, Hewitt, and AERG Chief Rennie Holt have written a lead article for the series with a basic review of the AMLR program and the 1991/92 field season. The remaining 11 papers, which have been written by AMLR program researchers, focus on individual components of the program. (J. Rosenberg, [619] 546-5600)

COASTAL FISHERIES RESOURCES DIVISION

La Jolla, California

Researchers Study Growth Rates of Dover Sole Larvae

The growth rate and time that Dover sole larvae spend in the plankton is an important factor determining recruitment variability. Dover sole hatch at about 8 mm and reach a size of 45 to 55 mm before settling to the bottom. Their larvae are present in the plankton year-round and may be planktonic for more than one year. Little has been known until recently, however, about the age and growth rate of these larvae.

To learn more about the age and growth rate of Dover sole larvae, Fisheries Biologist John Butler and Biological Technician Kathy Dahlin have been reading daily increments in otoliths to determine growth rates and duration of the larval phase. Daily increments in larvae up to 30 mm have been imaged using scanning electron microscopy (SEM), Figure 1. The width of the daily increments range from 0.3 to 0.7 μ and averages 0.5 μ. The radius to the first increment averages 10.3 μ.

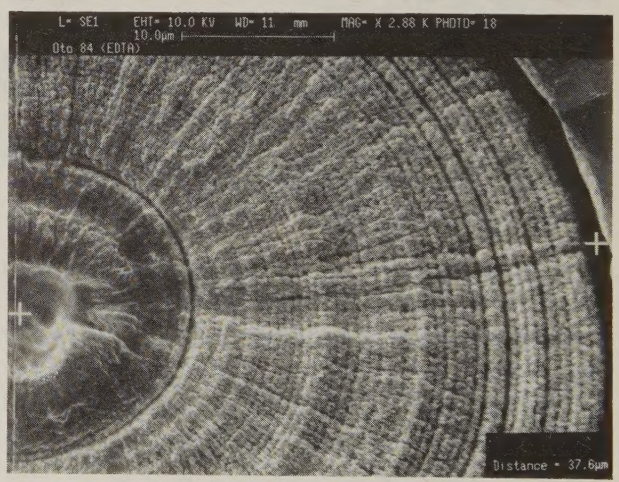

Figure 1. Scanning electron microscopy of the sagitta of an 18.3 mm Dover sole larvae. Distance from core to outer edge is 39 μ. Width of smallest increments is about 0.5 μ, which is the limit of resolution of light microscopy. Distance from center to first increment is about 10 μ. About 47 increments are visible.

The otoliths of 60 larvae ranging in size from 10 to 30.4 mm have been imaged. Butler and Dahlin found that these larvae range in age from 23 to 73 days and that the average growth rate is 0.27 mm per day (Fig. 2).

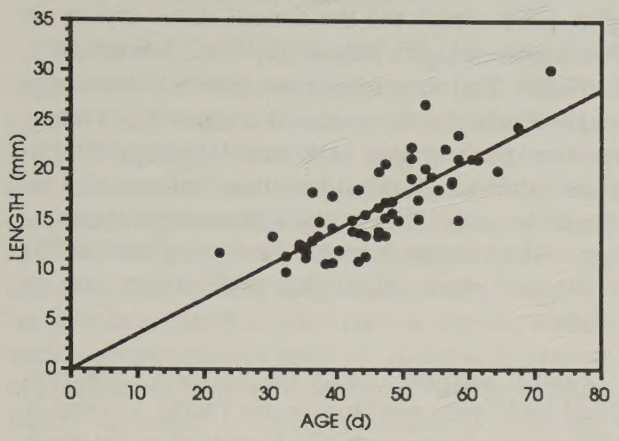

Figure 2. Size at age of Dover sole larvae less than 30 mm. The larvae were collected in July 1991.

Otoliths of larger Dover sole larvae form new centers of growth, making these otoliths more difficult to read because no single counting path from the center to the outer edge will provide a complete and accurate age. Butler and Dahlin will use combinations of light and SEM to determine the age of these larvae. (J. Butler, [619] 546-7149)

Scientists Study Dover Sole Spawning and Bathymetry off Central California

Dover sole is an important groundfish that is found along almost the entire west coast of California. Adult Dover sole live at mid-slope, at depths between about 600 and 1200 m. Coastal Fisheries Resources Division (CFRD) scientists know how to measure the biomass of Dover sole, but they now want to measure recruitment (the number of larvae that survive to maturity).

Their estimates of the size of the survey area for Dover sole larvae in the historical California Cooperative Oceanic Fisheries Investigations (CalCOFI) data base is 160,000 km^2. In comparison, the area in which the Dover sole spawn is only five percent of the total surface area occupied by the larvae. A central question in demersal (bottom living) fishes with pelagic (open-water) life stages is "How do the surviving planktonic fish larvae find their way to the appropriate bottom depth to complete the life cycle?" The alternation of benthic and pelagic stages of Dover sole makes this even more difficult along the west coast of North America because the continental shelf is narrow and the continental slope is steep.

Southwest Fisheries Science Center (SWFSC) scientists are now preparing a proposal entitled Fishery Oceanography Research and Groundfish Ecology (FORAGE), which will analyze the physical and biological requirements for recruitment for the major stocks of demersal fish, with Dover sole being one of the key species being studied.

One element of the FORAGE proposal is to test a hypothesis for Dover sole recruitment which states that simple turbulent diffusion of eggs and larvae is sufficient to account for average recruitment. The purpose of the study described here is to establish the principal conditions for random dispersal of larvae and subsequent settlement at the end of a 2-year pelagic egg-and-larval phase.

The pelagic habitat of Dover sole off central California may be defined as a rectangle with a 500 km baseline on the coast, 320 km offshore, with a depth distribution of 7 percent continental shelf (0-200 m), 5 percent upper continental slope (200-600 m), 5 percent mid-continental slope (600-1200 m), 13 percent lower continental slope (1200-3000 m), and 70 percent continental rise (3000+ m). The mid-continental slope is the spawning habitat of the Dover sole.

A life table of the pelagic phase of Dover sole can be constructed by assuming that the bimonthly average larval catch from the CalCOFI data base represents survival fitted with an exponential curve with time zero at March 1. The parameters of that curve are 1.101 larvae per 10 sq m (0.207 s.e.) intercept and instantaneous mortality rate of 0.006 (0.002 s.e.) daily for the whole area. This is a very low larval mortality; by comparison, the sardine and anchovy larval mortalities are over 0.2.

Lo et al. (1992) found 8,400 t of Dover sole female biomass in a 260-km reach of the central California coastline. Turnock and Methot (1992) found a Dover sole female virgin (pre-fishing) biomass of 60,000 t in a 278-km reach at the Oregon-California border. The two estimates of female biomass per km of coastline are 32.3 and 216 t. The eggs to be produced in a year by a female are 74,800 and the mean female weight is 664 g for an annual fecundity

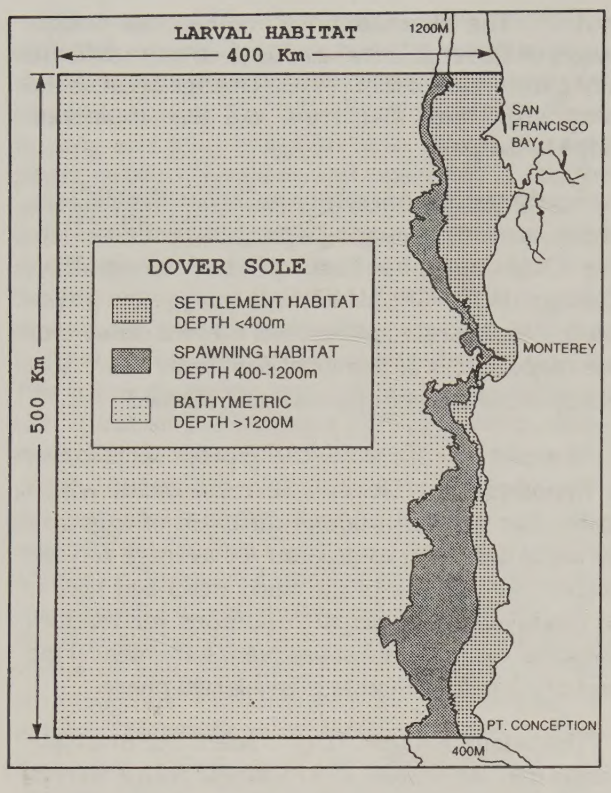

Figure 3. The coastline off California from San Francisco to Point Conception. The Dover sole spawning habitat is in the mid-continental slope area.

rate of 113 eggs per gram of female weight. Using the Lo value for tons of female biomass per unit of coastline, the number of eggs produced in the CalCOFI grid from lines 60 to 80 and offshore to station 90 is 500 km x (32.3 tons per km) x (1 million g per ton) x 113 eggs per gram of female weight, or 1,825 billion eggs per year. From the larvae, CFRD scientists find that at time zero, (500 km x 320 km) x .1101 larvae per square meter produced 17.6 billion at March 1.

Research by Fishery Biologist John Butler is under way on population models and larval age; and Geoff Moser is working on determination of vertical and horizontal distributions of egg and larvae from egg production studies, which will permit considerable refinement in these rough calculations. The scientists believe the major characteristics of the pelagic phase defined here will generally hold: a nearly point-source spawning area, a wide dispersion of larvae occupying an area 20 times that of the adult, and low natural mortality. (P. Smith, [619] 546-7169)

Status Report on Coastal Pelagics Fishery Completed

Industry Economist Cynthia Thomson and coauthors Gregory Walls, California Department of Fish and Game, Long Beach, and James Morgan, National Marine Fisheries Service, Southwest Region, have completed the annual status report on the coastal pelagics fishery (SWFSC Admin. Rep. LJ-92-25). The report describes trends in landings, major regulatory changes, and commercial and recreational participation in the coastal pelagic fisheries of California. It provides similar information on the market squid fishery and also contains information on the fisheries for coastal pelagic species (CPS) in Mexico. Some highlights of the report are as follows:

Pacific Sardine - Since the State of California lifted its 18-year moratorium on Pacific sardine in 1986, quotas have gradually increased as the stock has continued to exhibit increasing signs of recovery. Landings in 1991 included 6,191 t of directed harvest, 449 t for dead bait, 272 t for live bait, and 1,175 t of incidental take. From 1990 to 1991, directed landings increased about five-fold, dead bait landings doubled, live bait harvest decreased by almost 50 percent and incidental take remained approximately the same. Although the sardine population continues to show signs of recovery, the timetable for recovery and development of markets remains uncertain at this time.

Jack Mackerel - Several events in 1991 signaled potential interest by non-California vessels in developing an offshore fishery for jack mackerel: (1) A cooperative U.S.-Soviet cruise involving the search for commercial quantities of jack mackerel by the Soviet research vessel *Novodrutsk*, and (2) the acquisition of experimental permits to harvest jack mackerel by several factory trawlers from Alaska. These developments, along with the possibility of expansion of the Pacific sardine fishery to Oregon and Washington as that species rebounds, have prompted the Pacific Fishery Management Council to initiate development of a federal management plan covering jack mackerel, Pacific mackerel, and Pacific sardine as well as northern anchovy (which is already subject to federal regulation).

Pacific Mackerel - The 1990/91 season for Pacific mackerel closed with a total harvest of 39,977 t, a 60-percent increase over the 1989/90 harvest level.

Landings in the first half of the 1991/92 season totaled 17,248 t, 34 percent lower than landings for the same period in 1990/91 and 19 percent lower than average landings over the same period over the previous five seasons. For the seventh consecutive season, the fishery is expected to open in 1992/93 with no quota restrictions.

Northern Anchovy - The 1990/91 reduction fishery for northern anchovy closed with 1,037 t landed against a U.S. reduction quota of 116,200 t. The low levels of landings have been largely attributed to low ex-vessel prices. The reduction fishery was closed during 1991/92 and will likely remain closed in 1992/93 due to the low level of spawning biomass. In late 1991, the U.S. Food and Drug Administration found unsafe levels of domoic acid in some anchovy viscera samples. As a result, harvest of anchovy for human consumption was prohibited from November 1, 1991, to January 1, 1992, and shipments of anchovy from Monterey Bay and San Pedro were subject to embargo. Despite the domoic acid problem, nonreduction landings increased slightly from 3,145 t in 1990 to 3,157 t in 1991. The live bait harvest totaled 5,039 t in 1991, a modest increase over the 1990 harvest year and the highest level of harvest since 1982.

Market Squid - Market squid landings in southern California totaled 28,591 t in 1991, 40 percent higher than the 1990 harvest and 24 percent higher than the 1986-1990 average harvest for that area. The size of squid was consistently larger in 1991 than in the previous year, when the predominance of small squid contributed to low demand and landings. Market squid landings in Monterey Bay totaled 6,703 t in 1991, 15 percent lower than the 1990 harvest but 11 percent higher than the 1986-1990 average harvest. Most of the Monterey landings were caught in the area of Año Nuevo Island, an area that has been fished only sporadically since the 1983/1984 El Niño.

Commercial Harvesting Sector - The major harvesters of coastal pelagic species (CPS) and squid can be categorized as follows: (1) Round haul vessels that land at least 50 t of CPS during the year, and (2) round haul vessels that land less than 50 t of CPS but at least 50 t of CPS+squid during the year.

Category I vessels consist mainly of purse seiners with a median length of 51-60 ft; they are largely concentrated in San Pedro and to a lesser extent in Port Hueneme and Monterey. For the 49 vessels that fell into category I in 1991, average harvest per boat was 1,458 t (all species) with an ex-vessel value of $251,700 (1990 dollars). Average harvest was 7 percent lower than the 1990 average and 16 percent lower than the 1986-1990 average, while average revenues were 42 percent lower than the 1990 level and 51 percent lower than the 1986-1990 average. In 1991 these vessels obtained 55 percent of their revenues from CPS, 36 percent from squid, 1 percent from bonito and tuna, and 8 percent from all other species; by contrast, the revenue shares in 1990 were 53 percent from CPS, 17 percent from squid, 24 percent from bonito and tuna and 6 percent from all other species. These vessels accounted for 97 percent and 71 percent, respectively, of total statewide landings of CPS and squid in 1991.

Category II vessels consist mainly of lampara boats with a median length of 41-50 ft; they are largely concentrated in Monterey Bay and to a lesser extent in the Ventura/Santa Barbara area. For the 16 California vessels that fell into category II in 1991, average harvest per boat was 625 t (all species) with an average ex-vessel value of $142,800 (1990 dollars). Average harvest was 10 percent lower than the 1990 average and 15 percent higher than the 1986-1990 average, while average revenues were 27 percent lower than the 1990 average and 14 percent lower than the 1986-1990 average. Squid accounted for 93 percent of total landings and 76 percent of total revenues of these vessels in 1991. These vessels accounted for 25 percent of total statewide squid landings in 1991.

Mexican Harvest - Mexican landings of northern anchovy surpassed U.S. landings during 1977-1989 and comprised more than 90 percent of total landings by both countries during 1983-1989. In 1990 and 1991, however, Mexican landings fell to the lowest levels since the inception of that fishery in 1962. Overfishing, changing environmental conditions, and low demand have been cited as reasons for the fishery's demise. Landings of Pacific sardine in Ensenada were 11,375 t in 1990 and 31,392 t in 1991; by contrast, California landings were 2,802 t and 7,816 t in those same years. Ensenada landings of Pacific mackerel (35,767 t) exceeded California landings (31,794 t) in 1990 but declined to 17,500 t in 1991, while California landings remained roughly the same (30,957 t). (C. Thomson, [619] 546-7116)

MARINE MAMMAL DIVISION

La Jolla, California

BIOLOGICAL ASSESSMENT PROGRAM

Incidental Take of Small Cetaceans Observed in the Eastern Tropical Pacific

The following represents the observed incidental kill of small cetaceans on 40 U.S. tuna purse-seine and 794 California gillnet vessel trips in 1991. For the third consecutive year, there was 100 percent observer coverage on all U.S. tuna purse-seine vessels with fishing permits. The species most frequently killed as a result of tuna purse-seine fishing operations were the pantropical spotted dolphin, *Stenella attenuata*, spinner dolphin, *S. longirostris*, and common dolphin, *Delphinus delphis*. The two California gillnet (CAGN) fisheries sampled were the setnet fishery, targeted for halibut, *Paralichthys californicus*, and Pacific angel shark, *Squatina californica*; and the driftnet fishery targeted for common thresher shark, *Alopias vulpinus*, shortfin mako shark, *Isurus oxyrinchus*, and swordfish, *Xiphias gladius* (Herrick and Hanan, 1988). Nontarget

Table 1. Total observed kill of dolphins from the eastern tropical Pacific by geographic location (5° square block) and by sex, taken from 40 U.S. tuna purse-seine and 794 California gillnet vessel trips in 1991. M equals male; F equals female. Pantropical spotted dolphins, *Stenella attenuta*, and spinner dolphins, *S. longirostris*, are separated by stock. The total for each stock includes dolphins of unknown sex. Four dolphins unidentified as to species were not included in the table; all were of unknown sex. No kill was reported for coastal spotted or Costa Rican spinner dolphins.

5° block	Northern offshore spotted			Southern offshore spotted			Eastern spinner			Whitebelly spinner			Common		
	M	F	TOTAL	M	F	TOTAL	M	F	TOTAL	M	F	TOTAL	M	F	TOTAL
65	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
66	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
84	3	3	24	0	0	0	0	0	0	0	0	0	0	0	0
85	19	11	53	0	0	0	0	0	0	1	0	2	0	0	0
87	3	1	32	0	0	0	0	0	0	0	0	0	0	0	0
88	7	2	40	0	0	0	0	0	0	1	2	41	0	0	0
89	5	4	15	0	0	0	0	0	0	0	0	0	0	0	0
103	0	0	0	0	0	0	0	0	0	0	0	0	16	14	55
104	0	0	6	0	0	0	0	0	0	0	0	0	0	1	6
105	0	0	0	0	0	0	0	0	0	1	0	1	10	20	32
106	1	11	35	0	0	0	6	3	9	0	0	8	0	0	0
107	8	10	58	0	0	0	4	6	17	1	0	5	0	0	0
108	29	38	108	0	0	0	3	8	17	26	21	63	0	0	0
109	2	6	8	0	0	0	0	2	3	0	0	0	0	0	0
110	16	34	84	0	0	0	4	0	4	6	15	24	0	0	0
111	1	3	5	0	0	0	0	0	0	2	3	5	0	0	0
112	5	9	14	0	0	0	0	0	0	1	2	3	0	0	0
113	0	0	43	0	0	0	0	0	0	0	0	5	0	0	0
114	1	8	14	0	0	0	0	0	0	1	6	10	0	0	0
127	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
128	0	0	1	0	0	0	0	0	7	0	0	0	0	0	0
129	4	2	7	0	0	0	4	3	12	0	0	0	0	0	0
130	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0
131	22	23	52	0	0	0	9	5	18	0	0	0	0	0	0
132	3	3	13	0	0	0	0	0	0	5	4	9	0	0	0
133	0	2	8	0	0	0	0	0	0	3	3	7	0	0	0
149	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	130	171	629	0	0	5	30	27	87	49	56	184	26	35	93

Table 2. Length frequencies for all cetaceans with life history data collected from the eastern tropical Pacific U.S. tuna fishery and two California gillnet fisheries in 1991. M equals male; F equals female.

LENGTH (CM)	Eastern Tropical Pacific Cetaceans								California Temperate Cetaceans							
	Northern offshore spotted dolphin		Eastern spinner dolphin		Whitebelly spinner dolphin		Common dolphin		Northern rightwhale dolphin		Pacific white-sided dolphin		Common dolphin		Dall's porpoise	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
0-74	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
75-79	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
80-84	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0
85-89	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0
90-94	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
95-99	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100-104	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
105-109	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110-114	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
115-119	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0
120-124	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125-129	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
130-134	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
135-139	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
140-144	1	4	0	0	0	1	1	0	0	0	0	0	0	0	0	0
145-149	1	1	0	1	2	1	0	1	0	0	0	0	0	0	0	0
150-154	3	3	1	0	0	1	0	1	0	0	0	0	1	1	0	0
155-159	2	6	1	0	0	1	1	2	0	0	0	0	1	0	0	0
160-164	7	4	2	0	2	3	0	1	0	0	0	0	0	1	0	0
165-169	7	9	0	2	1	5	3	0	0	0	0	0	0	1	1	0
170-174	5	8	1	0	4	6	0	4	0	0	0	0	4	0	0	0
175-179	5	6	2	1	1	1	1	2	0	0	0	1	2	2	0	0
180-184	6	8	1	0	1	1	1	3	0	0	1	0	2	2	0	0
185-189	4	16	2	0	1	0	5	1	0	0	1	0	4	2	0	0
190-194	4	11	1	0	0	0	0	1	0	1	0	1	1	0	0	0
195-199	6	5	0	0	0	0	2	5	0	0	0	0	4	0	0	0
200-204	3	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0
205-209	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0
210-214	2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
215-219	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
220-224	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
225-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	65	90	12	5	19	31	18	23	0	4	2	3	23	10	1	0

species observed killed in the two CAGN fisheries include cetaceans, pinnipeds (California sea lions, *Zalophus californianus*; harbor seals, *Phoca vitulina*; elephant seals, *Mirounga angustirostris*; and sea otters, *Enhydra lutris*), and several species of seabirds and turtles. A total of 64 cetaceans was observed killed on driftnet trips: 44 common dolphins, *Delphinus delphis*, 7 northern right whale dolphins, *Lissodelphis borealis*, 5 Pacific white-sided dolphins, *Lagenorhynchus obliquidens*, 5 Risso's dolphins, *Grampus griseus*, 2 Dall's porpoise, *Phocoenoides dalli*, and one unidentified cetacean. Tally and life history data are also stratified by stock for the pantropical spotted dolphin (northern and southern), *Stenella attenuata*, and for the spinner dolphin (eastern and whitebelly), *Stenella longirostris*.

This is the first complete year that data were collected by observers for California gillnet fisheries. One thousand and two cetaceans were killed

Table 3. Reproductive conditions of female dolphins with life history data collected from the eastern tropical Pacific U.S. tuna fishery and two California gillnet fisheries in 1991. Percentages include females without reproductive information available. "Maturity undetermined" indicates that only minimum life history data were collected. N equals number.

	Eastern Tropical Pacific Dolphins								California Temperate Dolphins					
	Northern offshore spotted		Eastern spinner		Whitebelly spinner		Common		Northern right whale		Pacific white-sided		Common	
Reproductive condition	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Maturity undetermined	29	32.2	1	20.0	13	41.9	0	0.0	1	20.0	0	0.0	5	41.7
Sexually immature	28	31.1	2	40.0	8	25.8	16	69.6	0	0.0	1	33.3	3	25.0
Sexually mature:														
Condition undetermined	0	0.0	0	0.0	0	0.0	1	4.3	0	0.0	0	0.0	2	16.7
Pregnant only	6	6.7	0	0.0	0	0.0	0	0.0	0	0.0	2	66.7	0	0.0
Pregnant and lactating	7	7.8	0	0.0	0	0.0	2	8.7	0	0.0	0	0.0	1	8.3
Lactating only	11	12.2	1	20.0	6	19.4	2	8.7	1	20.0	0	0.0	0	0.0
Resting with a corpus luteum	2	2.2	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Resting without a corpus luteum	6	6.7	0	0.0	3	9.7	2	8.7	3	60.0	0	0.0	1	8.3
Post reproductive	1	1.1	0	0.0	1	3.2	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL	90	100.0	5	100.0	31	100.0	23	100.0	5	100.0	3	100.0	12	100.0

incidentally in the U.S. tuna fishery, and 69 were killed incidentally in the California gillnet fisheries sampled. For each set made, the observers recorded the species, stock, and sex of cetaceans involved, along with the geographic location of the school and tally of individual animals killed. Where life history data were collected, the summary also includes a length distribution for each species and sex as well as the reproductive condition and specimen length for the female cetaceans collected. Procedures for the collection of life history data have been described by Perrin et al. (1976). An example of the most recent life history form can be found in Hohn et al. (1991), and the data elements are described in Oliver (1991). (S. Chivers, [619] 546-7093; K. Peltier, [619] 546-7182; and S. Kruse, [619] 546-7181)

DOLPHIN STOCK ASSESSMENT PROGRAM

Estimates Made of Cetacean Abundance in the Eastern Tropical Pacific

Large-scale research vessel surveys were conducted annually from 1986 through 1990 by the U.S. National Marine Fisheries Service to monitor the abundance of dolphin populations in the eastern tropical Pacific Ocean (ETP).

The work relates to information needed on certain dolphin stocks that are killed during tuna purse-seining operations in the ETP. The major populations affected by the fishery are the offshore stock of spotted dolphins and the eastern stock of spinner dolphins. Scientists utilized two research vessels annually from 1986 to 1990 for 120 days each, for a total of five surveys. A stratified analysis incorporating line-transect methods was used. Sightings of all cetaceans were recorded, leading to the identification of 30 species. Data from all five surveys were pooled to give single estimates of abundance in the ETP for 25 stocks of cetaceans representing 19 species or genera.

The NOAA research vessels *David Starr Jordan* and *McArthur* traversed randomly placed predetermined tracklines in the ETP for approximately 120 days at sea in each year. When a school was initially detected, the observers estimated the angle and radial distance to the school. When possible, cetacean schools were approached to confirm species identification and to make estimates of school size. (P. Wade, [619] 546-7097; T. Gerrodette, [619] 546-7131)

Table 4. Abundance estimates (in thousands) for eastern tropical Pacific cetaceans. N_j is the estimate based only on identified sightings of the stock. N_j*(int) represents intermediate prorated abundance estimates from three categories of sightings not identified as to stock level involving six stocks. N_j* represents final abundance estimates, some of which were prorated from unidentified categories. (Note that the abundance estimates for species in the Globicephalinae and *Kogia simus* did not involve any prorating). CV represents the coefficient of variation for N_j*. N_j*$_U$ and N_j*$_L$ represent, respectively, the upper and lower 95 percent bootstrap confidence limits calculated using the percentile method. (Numbers have been rounded up to one decimal place.)

	N_j	N_j*(int)	N_j*	CV	N_j*$_U$	N_j*$_L$
Delphininae						
Stenella attenuata						
Northeastern spotted	668.9	674.4	738.1	0.2	989.6	574.8
West/south spotted	1258.9	-	1299.3	0.2	2121.4	910.1
Coastal spotted	25.6	27.2	29.9	0.6	87.0	16.2
Stenella coeruleoalba						
Northern striped	118.3	-	128.1	0.3	224.5	82.6
Southern striped	1612.5	-	1694.3	0.1	2129.6	1325.0
Stenella longirostris						
Eastern spinner	568.1	583.5	632.7	0.2	778.9	403.2
Whitebelly spinner	988.8	992.4	1020.1	0.2	1411.5	701.7
Delphinus delphis						
Northern common	433.6	-	477.0	0.5	903.7	106.7
Central common	379.2	-	415.6	0.5	840.7	170.0
Southern common	2127.7	-	2211.5	0.3	4310.4	1001.6
Lagenodelphis hosei	281.5	-	289.5	0.4	581.5	141.3
Tursiops truncatus	226.2	-	243.8	0.3	479.6	205.6
Grampus griseus	179.3	-	192.4	0.3	324.9	95.8
Steninae						
Steno bredanensis	141.4	-	151.1	0.3	256.6	103.6
Globicephalinae						
Globicephala spp.	-	-	160.2	0.2	207.2	106.2
Peponocephala electra	-	-	45.4	0.7	160.5	30.5
Feresa attenuata	-	-	38.9	0.3	67.8	20.4
Pseudorca crassidens	-	-	39.8	1.3	188.5	10.0
Orcinus orca	-	-	8.5	0.3	15.3	5.6
Ziphiidae						
Ziphius cavirostris	16.1	-	19.9	0.2	13.6	28.3
Mesoplodon spp.	20.3	-	25.3	0.3	13.9	42.7
Physeteridea						
Physeter macrocephalus	22.0	-	23.2	0.3	15.6	37.2
Kogia simus	-	-	11.2	0.3	19.8	8.1
Balaenopteridae						
Balaenoptera musculus	1.1	1.4	1.5	0.3	1.0	2.8
Balaenoptera edeni	9.6	11.8	12.8	0.3	9.1	25.3

COASTAL MARINE MAMMAL PROGRAM

Pinniped and Cetacean Mortality in California Gillnet Fisheries Estimated for 1991

The number of marine mammals that were killed in California gillnet fisheries has been estimated for the time period January-December 1991, based on observations made by technicians placed aboard commercial fishing vessels. A log-linear model is used to explore factors that may be correlated with entanglement, and it attempts to identify any potentially useful predictors of mortality. The model indicates that entanglement rates are expected to be higher during times of pinniped migration to and from breeding grounds and that of the two target species considered, pinnipeds may actually be attracted to the gillnets to forage on entangled California halibut. Geographic area, season, and selected fish catches are significantly associated with mortality of California sea lions and harbor seals in the halibut and angel shark setnet fisheries. The type of observation (randomly selected vs. systematically selected) may also affect apparent mortality rates. Water depth is significant for sea lions only. For the shark and swordfish driftnet fishery, only fish catch is significantly associated with marine mammal mortality. The estimated mortality (and standard errors in parentheses) for the setnet fisheries is 1858 (346.0) California sea lions, 559 (126.0) harbor seals, 26 (15.2) northern elephant seals, and 38 (18.3) harbor porpoise.

The estimated mortality (and standard errors in parentheses) for the driftnet fishery is 34 (22.3) California sea lions, 110 (31.7) northern elephant seals, 373 (88.0) common dolphins, 59 (27.5) northern right whale dolphins, 42 (30.2) Pacific white-sided dolphins, 42 (24.0) Risso's dolphins, and 17 (12.8) Dall's porpoise. Standard errors for the above mortality estimates are estimated based on the assumption that fishing effort is known without error. Comparisons of different measures of fishing efforts are made for the purpose of estimating total mortality. (J. Barlow, [619] 546-7178 and P. Perkins, [619] 546-7017)

HONOLULU LABORATORY

Honolulu, Hawaii

PROTECTED SPECIES INVESTIGATION

Starving Hawaiian Monk Seals Rescued from French Frigate Shoals

William G. Gilmartin, chief of the Protected Species Investigation, reported that seven undersized and severely emaciated Hawaiian monk seal juveniles from French Frigate Shoals (FFS) were brought to Oahu on May 7, 1992, in an attempt to save their lives. The poor condition of the seals is believed to be due to a lack of food to support the FFS population.

Two of the seals, both males, could not be saved; they died several days after their arrival. Necropsies and tests did not reveal the exact cause of death. The other seals, all females, are being carefully monitored in a holding pen on a secluded beach at the Marine Corps Air Station, Kaneohe Bay. The holding pen provides a protected, disturbance-free area in which the seals may recover. The beach will remain off-limits to ensure the isolation of the seals.

All five female seals are eating on their own and now appear to be in generally good health, based on veterinary examinations.

The most emaciated seal initially required daily force-feeding, but on June 1 she began feeding on her own. She was also treated successfully for pneumonia, and subsequently her behavior and overall health have improved significantly.

Scientists will await test results to confirm that the seals are free of disease. When the results indicate the seals are healthy, they will be transported to Midway where they will be held in an ocean-beach enclosure for up to an additional two months. At Midway, the seals must gain weight and be able to catch food on their own before they are released into the wild population. After release, their survival will be monitored closely for comparison with similarly sized seals at FFS.

Currently, the monk seal population at Midway is severely depleted, but scientists believe the food resources there are sufficient to support additional seals. More undersized or emaciated seals may be collected and transported to Midway for rehabilitation if the status of the FFS population does not improve.

The FFS seal population has declined 25 percent since 1989. Ongoing studies attempt to determine the cause of the decline and, in particular, why young FFS seals are starving. A team of scientists visited the area in early April to investigate these problems. Composed of a veterinarian, a virologist, and Gilmartin, the team tested 19 juvenile seals for disease. Their results suggest that the poor condition of juveniles is not due to an infectious disease. Instead, the problem appears to be a lack of food.

In July, Honolulu Laboratory scientists will assess the reef fish populations at FFS. Their results will be compared with a similar assessment made a decade ago, to determine the extent of the decline in the monk seals' food source. (W. Gilmartin, [808] 943-1239)

NOAA Scientists Report Incidence of Sea Turtles with Tumors Continues to Increase

George H. Balazs, leader of the Marine Turtle Research Program, reported that a disabling, life-threatening tumor disease has reached epidemic proportions in a Hawaiian green sea turtle population off the island of Molokai, where no cases of the disease had been reported prior to October 1985.

The tumor disease was diagnosed in more than half the green turtles captured and examined at Palaau, a shallow reef area off Molokai, during a recent survey by Balazs. Balazs periodically surveys the sea turtles in waters around Molokai, in cooperation with the State of Hawaii Division of Aquatic Resources and with local residents who are knowledgeable about turtles.

The disease, known as fibropapilloma, causes unsightly tumors and eventually leads to the death of its victims. Growing up to 12 inches in diameter, the tumors can break out at a number of locations on turtles: in their mouths, throats, and nasal passages, hindering breathing and making eating difficult or impossible; on their eyes, severely impairing vision and increasing their vulnerability to predators; on their jaws, necks, tails and flippers, impairing movement and swimming ability.

The first case of the tumor disease at Palaau, Molokai, was diagnosed in October 1985 and the second in June 1987. Since then, the incidence of afflicted turtles has risen about five percent each year. Balazs plans to conduct another survey in mid-July to confirm that the tumor disease is as prevalent in the Palaau population as recent results indicate.

Scientists do not know what causes fibropapilloma, how it spreads, nor what its impact will be on the recovery of the Hawaiian green turtle. Balazs is working with disease specialists in Hawaii and on the U.S. mainland to determine the cause of fibropapilloma. Possible causes being examined are pollutants and blood parasites specific to sea turtles.

According to Balazs, the exact cause of the disease is not known, but scientists do know that the disease is specific to turtles and therefore is not a direct health concern to humans.

Statewide, the percentage of turtles with tumors has been increasing among those found stranded ashore, dying, or dead. Large numbers of afflicted turtles have been sighted off the island of Oahu at Kaneohe Bay, Haleiwa Harbor, in the ocean off Hawaii Kai, and even at Hanauma Bay.

Some study sites, however, are still free of the tumor disease; there has been no sign of the disease in hundreds of turtles examined over the past 4 years at Kiholo Bay, Punaluu, and at Puako on the island of Hawaii. (G. Balazs, [808] 943-1240)

PELAGIC RESOURCES INVESTIGATION

Scientists Study the Effects of Entanglement on North Pacific Albacore that Escaped High-seas Driftnets

As part of a large effort to determine the impacts of driftnets on the stock of North Pacific albacore, *Thunnus alalunga*, scientists of the Honolulu and La Jolla Laboratories examined whether net-scarred and normal albacore caught by U.S. trollers differed in measures of condition, short-term and long-term growth rates, and indications of systemic infection. Such research is important because if the as-yet-unknown fraction of albacore becoming entangled and subsequently dropping out is significant, the North Pacific albacore stock could be impacted more seriously by high-seas driftnets than landings indicate. In addition, North Pacific albacore are heavily overfished and may have experienced recent declines in recruitment. Catches and catch-per-unit effort (CPUE) by the U.S. troll fishery have been declining since the 1960s and are currently only about 50 percent of their peak levels. Catches and CPUE of the Japanese pole-and-line fishery also have been declining continuously since the late 1970s. North Pacific albacore are also taken by longliners; high-seas, large-mesh driftnet fleets

Table 1. Parameters measured to determine the effects of escapement from driftnets on the relative fitness of albacore, *Thunnus alalunga*.

Parameter	Normal fish		Net-scarred fish	
	Mean ± SD	N	Mean ± SD	N
Body weight* (kg)	10.6 ± 2.4	182	8.6 ± 2.6	83
Fork length* (cm)	79.1 ± 7.4	215	73.5 ± 7.9	114
Maximum girth* (cm)	56.1 ± 5.7	214	51.8 ± 6.2	113
Condition factor (kg/cm^3)	0.0208 ± 0.0015	182	0.0210 ± 0.0017	83
Relative girth	1.00 ± 0.02	214	1.00 ± 0.03	113
Relative condition factor	1.00 ± 0.07	182	1.00 ± 0.07	83
RNA:DNA ratio	6.99 ± 0.97	34	6.90 ± 1.49	36
Relative otolith weight	1.00 ± 0.09	175	0.99 ± 0.11	47
Leukocytes/200 red cells	7.26 ± 5.30	15	6.44 ± 3.59	35

*$P \leq 0.05$

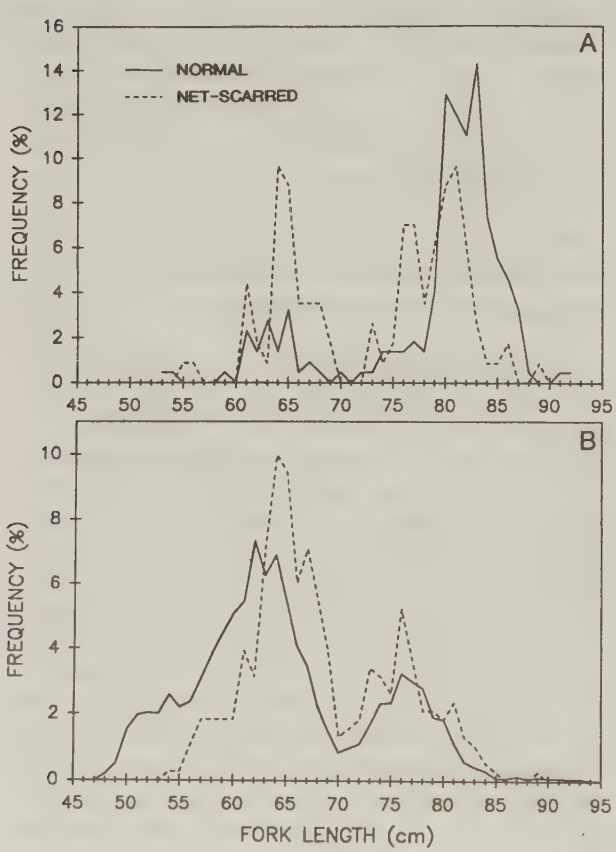

Figure 1. Size-frequency distribution of the net-scarred and normal albacore: (A) Sampled in the present study and (B) a much larger data set from fish caught in the same areas (these data are from N. Bartoo, D. Holts, C. Brown, and L. Halko of the La Jolla Laboratory).

of Japan and Taiwan; and small-mesh driftnet fleets of Japan, Taiwan, and Korea.

In this study, length-weight data, otoliths, blood smears, and white muscle samples were collected from net-scarred and normal albacore during 1990 and 1991 by observers placed aboard 10 U.S. trollers by the Honolulu and La Jolla Laboratories in cooperation with the Western Fishboat Owners Association. The trollers operated in North Pacific areas bounded by 52°40′ N, 145°52′ W and 42°33′ N, 129°48′ W (i.e., within the North Pacific Transition Zone north of Midway Islands, as well as offshore and in U.S. coastal fishing grounds).

Only one significant difference was found between net-scarred and normal fish: normal albacore were larger (mean fork length, body weight, and maximum girth; Table 1). These data imply that small fish escape from driftnets, survive, and are recaptured by the trollers more frequently than large fish. Although this result appeared to be confirmed by the size-frequency distribution of the sampled fish (Fig. 1A), it is most likely due to sampling bias of the observers or to time-area variations in fish size composition and the percentage of net-scarred fish. The size-frequency distribution of a larger sample of albacore (12,085 normal and 381 net-scarred individuals) captured in the same areas as the fish sampled for this study, show that normal fish tended to be smaller than net-scarred fish (Fig. 1B).

The lack of differences between normal and net-scarred albacore caught by the U.S. troll fleet indicates that the fish escaping from driftnets and living long enough to resume feeding (i.e., become vulnerable to recapture by trollers) probably do not suffer increased natural mortality. These data do not imply, however, that fishing mortality due to high-seas driftnets is limited to actual landings. As shown in Figure 2, a variety of fates may befall albacore that become entangled. This study could only compare animals that had never become entangled with those that were probably not badly injured and had lived long enough to resume feeding. The percentages of albacore falling out dead or escaping so badly injured that they succumb before

becoming vulnerable to troll vessels may well be significant but still remain to be determined. [See La Jolla's related report "Scientific Observers Placed on Board U.S. Albacore Troll Vessels."] (R. Brill, [808] 943-1234 and D. Holts, [619] 546-7186)

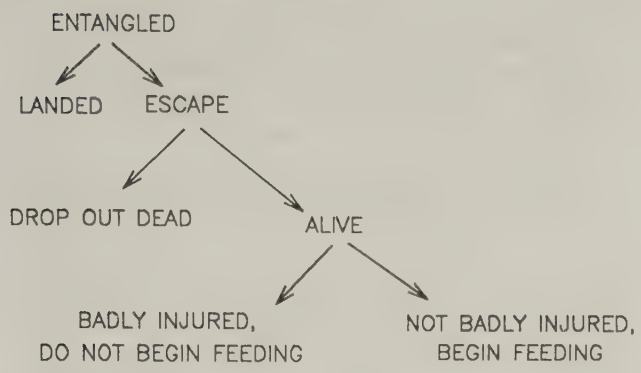

Figure 2. The possible fates of albacore that become entangled in driftnets.

INSULAR RESOURCES INVESTIGATION

Scientist Evaluates the Management Potential of Marine Fishery Reserves

Edward E. DeMartini, leader of the Insular Ecology Program, recently completed the manuscript "Modeling the potential of fishery reserves for managing Pacific coral reef fishes." In the manuscript he states that marine fishery reserves (MFR) provide a new, but controversial, alternative to conventional fisheries management measures such as size and bag limits, closed seasons, and limited entry and that although the potential contribution of MFRs to spawning stock conservation for recruitment/overfished resources is generally appreciated, to date little has been done to quantify MFR potential to enhance yield per recruit (Y/R) or spawning stock biomass per recruit (SSB/R) of growth-overfished resources.

Using Polacheck's (Nat. Res. Model, 1990) extension of the Beverton-Holt Y/R model, DeMartini conducted a simulation study to evaluate the relative importance of year-round closure size, fishing mortality rate, and size at first capture for several representative types of Pacific reef fishes that differ in growth, natural mortality, and fundamental "transfer" (emigration, immigration) rates.

DeMartini constructed three hypothetical "fish types," based in part on published and unpublished data for several populations of Pacific fish species. The fish types bracket the likely extremes in fundamental transfer rates and related life-history parameters of Pacific coral reef fishes: a small-bodied, fast-growing, short-lived, strongly philopatric "damselfish"; a large-bodied, long-lived, relatively slow-growing vagile "jack"; and, representing intermediate parameter values, a "surgeonfish."

DeMartini's simulations corroborate Polacheck's modeling results (for Arctic-boreal gadids) which indicate that MFR contribute little, if anything, toward increasing Y/R. Results for the highly mobile jack confirm that rapid transfer rates will negate potential gains in SSB/R resulting from closures. At the opposite extreme, because of negligible transfer rates, small reef philopatriots such as damselfishes will never be harvested unless the MFR is periodically opened to fishing.

DeMartini's simulations suggest that the SSB/R of the surgeonfish type is the most likely to benefit from MFRs: its moderate vagility allows biomass to accumulate within the closure, despite fish being harvested in the non-closed (open) area (Fig. 3). If, however, fundamentally moderate transfer rates are adjusted for likely density-dependent emigration from a closed area as relative densities decrease in a surrounding non-closed area because of continued fishing, closure benefits are dampened by the

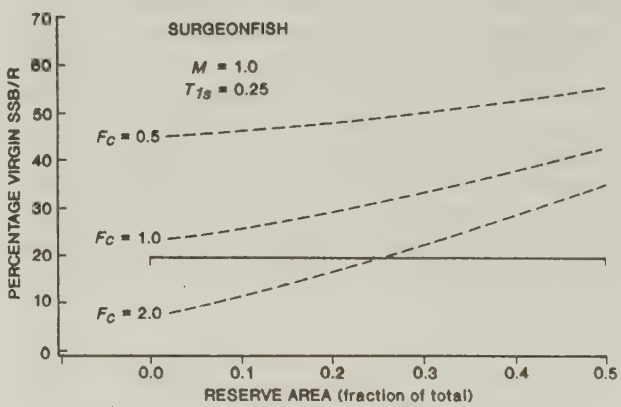

Figure 3. Relative changes in spawning stock biomass per recruit (SSB/R) as a function of reserve size, compared at each of three fishing mortality rates (F_c), for surgeonfish with a natural mortality rate (M) of 1.0 and a fundamental transfer rate (T_{1s}) of 0.25. The solid horizontal line indicates the level at which spawning biomass falls below 20 percent of the virgin spawning biomass. Note the positive effect of reserves <<10 percent total area when $F_c \leq 1.0$.

more rapid emigration of fish from the reserve. Results further suggest that growth rate, fishing effort in the non-closed area, natural mortality, and maturity and harvesting schedules greatly influence the potential of MFRs to augment SSB when transfer rates are low to moderate. Clearly, the potential of MFRs to help manage reef resources is "life-history specific." Recognition of the important influence of basic life-history patterns might reasonably assist managers responsible for evaluating whether closures of certain sizes could benefit stocks of particular types of reef fishes.

A paper based on the manuscript was presented at the Seventh International Coral Reef Symposium, held June 21-26, 1992, in Tumon Bay, Guam. (E. DeMartini, [808] 943-1266)

FISHERY MANAGEMENT AND PERFORMANCE INVESTIGATION

Northwestern Hawaiian Islands Lobster Fishery Gets a Limited Entry System and a Closed Fishing Season

At the February 1991 meeting of the Western Pacific Regional Fishery Management Council (WPRFMC), representatives from the lobster fishing industry and researchers from the National Marine Fisheries Service (NMFS) recommended additional methods for managing the lobster fishery in the Northwestern Hawaiian Islands (NWHI). These recommendations were in response to concerns about the general deterioration of lobster stocks and the fact that at least one of the NWHI banks had experienced recruitment failure. Recommendations included a limited entry system, transferability of permits, and an emergency 90-day closure of the fishery, effective August 13, 1991. The fishery reopened on November 11, 1992, but only a fraction of the vessels that had fished earlier in the year participated in the fishery in late 1991 and early 1992.

During the closure, the WPRFMC and the NMFS amended the Fishery Management Plan to implement these recommendations as a system of limited entry (15 vessels): A fleet-wide combined legal spiny and slipper lobster quota of 750,000, freely transferable permit gear restrictions (maximum of 1,000 assembled lobster traps and 100 unassembled replacement traps), and an annual closed season from January 1 through June 30. Amendment 7 was published in the *Federal Register* on March 26, 1992, and the last two regulations took effect on April 27, 1992.

Although the number of permitted lobster vessels decreased from the 1991 total of 23 to the mandated 15 during the first quarter of 1992, the number of active vessels increased from 9 to 11 for the 1992 season beginning July 1, 1992.

Effort data for the NWHI lobster fishery for the period January 1 through the first week of April 1992 (the fishery was closed on April 10, 1992) were almost identical to data for the first quarter of 1991: 4 lobster vessels fished for 6 trips, and total effort was approximately 138,000 trap-hauls.

Legal-sized catch during first quarter 1991 was 57,934 spiny and 15,966 slipper lobsters, compared to a first quarter 1992 total of 63,658 and 7,575, respectively. Catch-per-unit effort (CPUE) was 0.42 for spiny and 0.12 for slipper lobsters for first quarter 1991, compared to 1992 CPUE of 0.46 and 0.05, respectively. Figure 4 is a comparison by quarter of the NWHI lobster catch and effort for 1991-92.

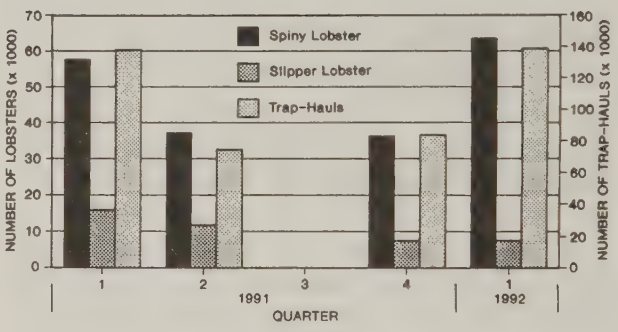

Figure 4. Quarterly catch and effort by the lobster fishery in the Northwestern Hawaiian Islands, January 1991-April 1992. The fishery was closed May 8-November 11, 1991; the first week of April is included in the first quarter of 1992 because the fishery was closed on April 10.

PACIFIC FISHERIES ENVIRONMENTAL GROUP

Monterey, California

Bakun Leaves Laboratory for FAO

On June 1, 1992, Chief of the Pacific Fisheries Environmental Group (PFEG) Andrew Bakun left for a position as an oceanographer with the United Nations Food and Agriculture Organization (FAO)

in Rome, Italy. Bakun had been at the PFEG since 1971, first as a research scientist, and from 1978 to 1983, as a task leader. In 1983, he was promoted to PFEG Chief.

Bakun was an early expert in the use of large electronic computer systems and computerized data bases to study natural variability in marine ecosystems which support economically important fish stocks. Bakun is best known for the "Coastal Index," a measure of the seasonal but highly variable upwelling processes off the U.S. coasts of North America, an index based on analyses of alongshore wind stress and pressure gradient patterns.

With the collaboration of Task Leader and Fishery Biologist Richard Parrish of the PFEG, Bakun has formulated scientific approaches incorporating interregional comparative studies, exploratory time series analysis, and recognition of patterns in life history adaptations, to promote a more consistent and rigorous framework for fishery/environmental research efforts.

At FAO, Bakun will be conducting research on environmental conditions and how they affect fisheries as well as serving on committees involved with oceanographic and other environmental concerns, one of which is the Intergovernmental Oceanographic Commission in Paris, France.

PELAGIC FISHERIES RESOURCES DIVISION

La Jolla, California

SWFSC Hosts Western Pacific Yellowfin Tuna Research Group Meeting

The second meeting of the Western Pacific Yellowfin Tuna Research Group (WPYRG) was held at the East-West Center in Honolulu, Hawaii, June 17-24 and was hosted by the National Marine Fisheries Service's (NMFS) Southwest Fisheries Science Center. Al Coan, Donna Da Rodda, Karen Handschuh, and Doug Prescott of the Pelagic Fisheries Resources Division (PFRD) and Diane Foster of the Coastal Fisheries Resources Division organized and provided support services for the meeting, including computer support. Gary Sakagawa, Chief of PFRD, chaired the meeting.

The WPYRG was organized in 1990 to facilitate collaborative research on western Pacific yellowfin tuna for management advice. The members, who have an interest in research and management of the tropical tunas of the western Pacific, are scientists and fishery officers of the South Pacific island nations, distant-water fishing nations, the South Pacific Commission (SPC), and the Forum Fisheries Agency.

Twenty-six participants from Australia, the Federated States of Micronesia, Fiji, French Polynesia, Indonesia, Japan, the Marshall Islands, New Caledonia, New Zealand, Palau, the Philippines, the Solomon Islands, Taiwan, and the United States took part in the second meeting. The objectives of the meeting were to (1) prepare a data base for conducting a comprehensive stock assessment by 1993 or 1994, and (2) outline specifications for conducting that stock assessment.

To meet objective one, the group focused on securing and compiling data to develop a catch-by-size data base. Some participants contributed data in advance of the meeting. Detailed descriptions on how data were collected were provided by the participants. The group analyzed the data and concluded that in constructing the data base, time-area stratification of longline fishery data is important, whereas time-area and set-type stratification is important for purse-seine fishery data. The group also took note of the significant increase in catch from the period 1970 to 1990. The longline fishery catch of yellowfin tuna increased by approximately 50 percent over this period to 54,000 t in 1990, and the surface fishery catch increased by about 600 percent over the same period to 253,000 t in 1990.

The group agreed to postpone creation of the master data base for 6 months because the volume of data received at the workshop was large, additional data sources were identified, and some data needed to be rechecked against the original records. During that period, members will work on the missing pieces. NMFS was assigned responsibility for coordinating this work.

To meet the second objective, the group reviewed available information on the population biology of the western Pacific yellowfin tuna, focusing on parameters necessary for a stock assessment. This review included information on stock structure, age and growth, reproductive biology, mortality rates, and catch-per-unit effort (CPUE) indices. The group concluded that there is currently insufficient information on the population biology of the western Pacific yellowfin tuna for conducting an

assessment with an age-structured model. It recommended instead that research be focused on the long-term goal of closing the information gaps identified by the group. The near-term research, especially on the condition of the stock and estimate of potential yield, should focus on analysis of CPUE data held by different agencies and tag-recapture data held by the SPC.

The group developed a work plan for 1992/93 and will meet in 1993 to review results and progress. The venue and time for the third meeting will be announced after consultation among members and the SPC. (G. Sakagawa, [619] 546-7177)

STOCK ASSESSMENT AND FISHERY IMPACT ANALYSIS PROGRAM

1992 Albacore Tuna Forecast is Distributed

The staff of the Pelagic Fisheries Resources Division (PFRD) has prepared and distributed the 1992 Albacore Tuna Forecast to interested subscribers. The following forecast was also presented at several public meetings:

Summary - The overall outlook for the 1992 U.S. North Pacific albacore fishery is for moderate production, with potential for catches greater than those of the last few years. The current El Niño and the associated oceanographic events should make albacore availability highest in waters off the Pacific northwest and Canada. Albacore are expected to arrive along the coast of the Pacific northwest in mid- or late July although some earlier arrivals off southern and central California may be seen. The availability of albacore along the central and southern California coast will depend on upwelling and frontal structures which have not yet developed. Currently, upwelling and frontal boundaries are much weaker than average although some frontal development is currently seen near shore along the California central coast. Relatively strong northerly winds in June or July will help create favorable oceanographic frontal boundaries which may increase the availability of albacore on a local scale. Sportfishing for albacore in the southern California Bight is expected to be poor unless local frontal boundaries and temperature gradients develop. Based on previous experience, there is a higher-than-average chance that yellowfin, skipjack, and bigeye tunas as well as other warm water fish will be more plentiful than albacore in the Bight and possibly along the mid-California coast.

Background - The current El Niño event dominates much of the oceanographic developments. Off Japan, frontal boundaries and temperature gradients are much stronger than average which tends to slow the movements of albacore away from Japan to the east. Sea surface temperatures (SST) in the mid-North Pacific are higher than average north of 45° N latitude and cooler to the south. This results in very weak boundary features in the North Pacific Transition Zone (NPTZ) from the international dateline east to the coast of North America. In addition to having weak frontal structures, the NPTZ is wider than average, extending both north and south several degrees of latitude. These combined features should reduce albacore concentrations and availability in the NPTZ.

From 135° W longitude eastward along the coast of North America, SSTs are much warmer than average. Coastal upwelling is much lower than normal and has been so since winter. Some nearshore upwelling occurred in late May along the central California coast. Increased upwelling will contribute to good fishing locally. Continued weak upwelling and associated weak frontal structure may allow albacore to concentrate closer to shore but may also reduce availability by dispersing them. The southward flow of the California Current south of Pt. Conception was weak to nonexistent until April. This results in weak frontal boundaries in the Bight and low planktonic production, which contribute to reduced albacore availability. Reversal of these conditions could occur over a relatively short time period and should improve albacore availability.

Catch information is not yet available from the central Pacific. Preliminary reports from the Japanese pole-and-line fishery in the west-central Pacific indicate albacore catches are low; however, for economic reasons the fleet is directing its effort toward skipjack and not albacore. (N. Bartoo, [619] 546-7073)

Scientific Observers Placed on Board U.S. Albacore Troll Vessels

Scientific observers are being placed on U.S. albacore troll vessels for the 1992 fishing season to document direct fishery interaction in the U.S. North Pacific albacore fishery. The Pelagic Fisheries Resources Division has for the last two seasons placed observers on U.S. troll vessels to look for injuries or marks on landed albacore after encounters with high-seas driftnets.

Observers Jeff Nelson and Greg Spencer have both departed from Honolulu aboard troll vessels. One or two additional observers are planned for placement in July. They will probably be on vessels departing from west coast ports. Observers will be

repeating procedures used in 1990 and 1991; that is, they will be looking for marks, determining the extent of injuries, and measuring fish caught.

In 1990 and 1991, observers examined a total of 32,000 albacore for net marks and measured most for both fork length and maximum girth. Gillnet marks were identified on 12.4 percent and 3.1 percent of the observed catch, respectively. [See Honolulu's related report "Scientists Study the Effects of Entanglement on North Pacific Albacore that Escaped High-seas Driftnets."] (D. Holts, [619] 546-7186)

MULTISPECIES DATA COLLECTION AND EVALUATION PROGRAM

43rd Annual Tuna Conference Held

The 43rd Tuna Conference, co-chaired by Al Coan and Alan Jackson of the Southwest Fisheries Science Center in La Jolla, was held at the University of California's Conference Center at Lake Arrowhead, California, May 18-21, 1992. The joint sponsors, the National Marine Fisheries Service and the Inter-American Tropical Tuna Commission, provided an excellent venue for participants to share their views on tuna and billfish-related topics. This year's Conference was attended by nearly 70 participants, representing the tuna industry, academia, and governmental and private agencies. A total of 34 papers and 7 posters were presented. The Conference attracted participation from the United States, Mexico, Canada, Japan, Australia, Italy, Russia, New Caledonia, Sri Lanka, France, and the Seychelles.

The theme of the 43rd Tuna Conference, "Fisheries and Ecological Interactions," was particularly apropos. Increased competition over tuna resources has made gear and species interactions a major concern, especially when its possible effects on stock abundance and maximum sustainable yields are considered. Confrontations, sometimes violent, have emerged as participants in various fisheries try to maintain their access rights to a limited resource. Confrontations have also evolved concerning interactions of fishing gear and marine mammals. The papers presented at the Conference addressed some of these problems as well as other research pertinent to tunas and billfish. (A. Jackson, [619] 546-7079)

TIBURON LABORATORY

Tiburon, California

GROUNDFISH COMMUNITIES INVESTIGATION

Transformation of Nearshore Habitat Continues with Increases in Purple Sea Urchin

Changes in the nearshore habitat along the Mendocino Coast have been noted since the fishery for red sea urchins, *Strongylocentrotus franciscanus*, began there in 1985. These changes have been recorded during a long-term study of that habitat by Ted Hobson, Tony Chess and Dan Howard, of the Groundfish Communities Investigation. The Southwest Fisheries Science Center's (SWFSC) Bimonthly Report for November/December 1988 described the expansion of areas forested by bull kelp, *Nereocystis luetkeana*, following the sharp decline of red sea urchins that occurred during the early years of the fishery. The SWFSC's Bimonthly Report for May/June 1990 then described an increasing algal understory, composed mainly of *Pterygophora californica*, that was reducing the areas forested by bull kelp.

A third phase appears to be under way as aggregations of the purple sea urchin, *Strongylocentrotus purpuratus*, which had been limited to a shallow-water habitat near shore, are now occurring in the

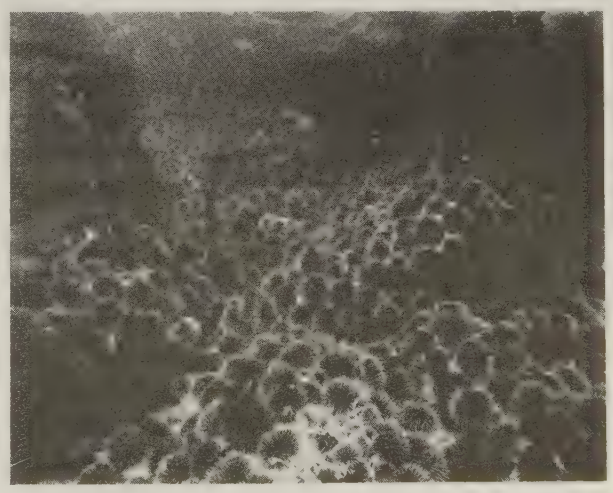

Figure 1. Aggregation of purple sea urchins, *Strongylocentrotus purpuratus*, on the Mendocino coast.

deeper zone formerly occupied by *S. franciscanus*. *S. purpuratus* is smaller than *S. franciscanus* and is not regularly fished. It forms denser aggregations (Fig. 1) and feeds heavily on benthic algae. So far, this species has entered only highly localized areas of the deeper zone, but virtually all the attached vegetation has been removed in locations where it occurs. (E. Hobson, [415] 435-3149)

Diets of Shortspine and Longspine Thornyheads Compared

In recent years, there has been an increased fishery for the shortspine thornyhead, *Sebastolobus alascanus*, and the longspine thornyhead, *S. altivelis*–both major components of the deep-slope community under study by the Groundfish Communities Investigation. Because needed information on the biology of these two species has been lacking, Fishery Biologists Tom Laidig and Pete Adams have completed an analysis of their trophic relations.

The analysis is based on examination of stomach contents of 1,534 shortspine thornyheads and 1,366

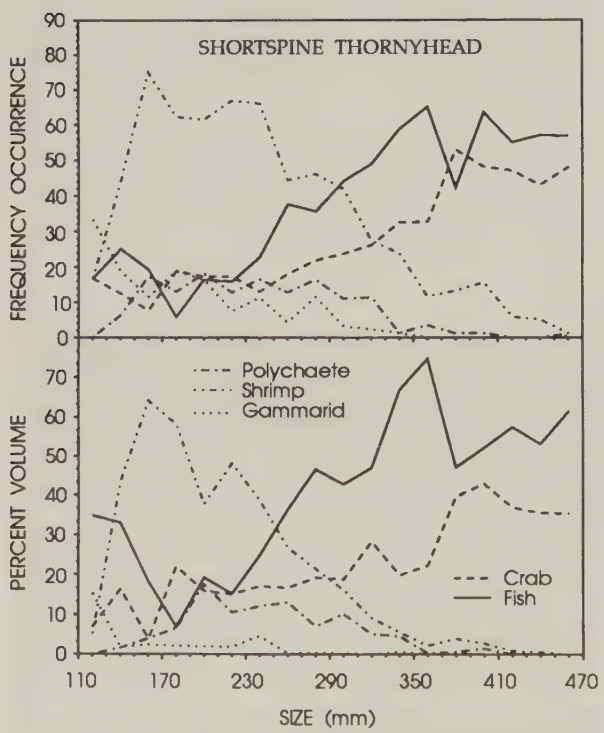

Figure 2. Prey of the shortspine thornyhead, *Sebastolobus alascanus*. The top part of the figure shows frequency of occurrence for each prey and the bottom gives the percent each is of the total volume of prey.

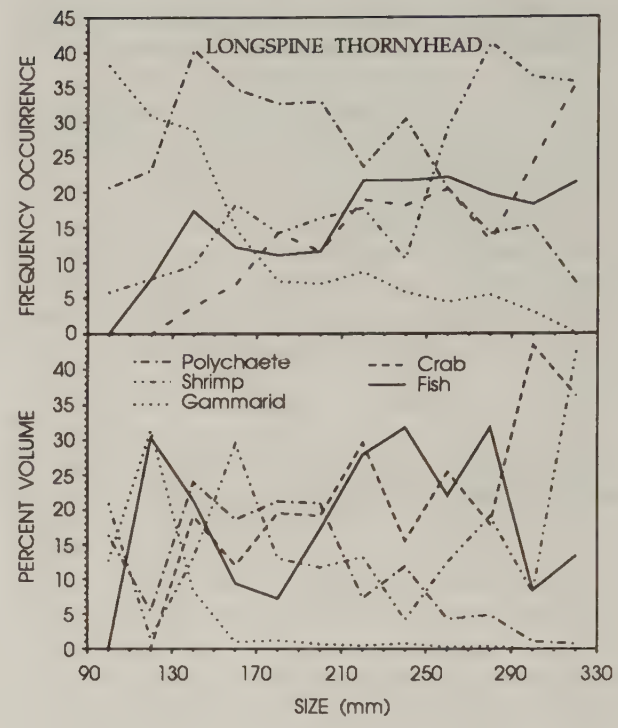

Figure 3. Prey of the longspine thornyhead, *Sebastolobus altivelis*. The top part of the figure shows frequency of occurrence for each prey and the bottom gives the percent each is of the total volume of prey.

longspine thornyheads taken from seven cruises between 1988 and 1991. A comparison of stomach contents over the size ranges sampled (Figs. 2 and 3) shows that both species experience a change in diet at about 260 mm in length but that different prey are involved. Whereas the shortspine thornyhead shifts from a diet that is mainly shrimp to one that is mainly fishes and crabs, the longspine thornyhead shifts from feeding mainly on polychaetes to feeding mainly on crabs and shrimp. No differences were noted that could be related to location or time of capture.

The major prey of the large piscivorous shortspine thornyhead was longspine thornyhead (10.6 percent of the total prey volume); and while fishes were less important as prey to the longspine thornyhead, the shortspine thornyhead was nevertheless among the species taken. There was one instance of cannibalism by the longspine thornyhead and two by shortspine thornyheads. (T. Laidig, [415] 435-3149)

GROUNDFISH ANALYSIS INVESTIGATION

Study Completed on Pelagic Juvenile Sanddabs

Keith Sakuma has finished his Master's thesis at San Francisco State University on the "Pelagic distributions of juvenile sanddabs, *Citharichthys sordidus* and *C. stigmaeus*, off central California." His thesis and his research project required the collection of pelagic juvenile Pacific sanddabs, *Citharichthys sordidus*, and speckled sanddabs, *C. stigmaeus*, which were collected in conjunction with the annual juvenile rockfish surveys aboard the *David Starr Jordan*. Sakuma recorded the stage of metamorphic development and standard lengths for all individuals collected during 1990 and 1991. Five metamorphic stages were established as follows:

Stage 1 = Position of eyes equal on both sides of the head

Stage 2 = Right eye has begun to migrate toward the top of the head

Stage 3 = Right eye has reached the top of the head

Stage 4 = Right eye has begun to cross over to the left side of the head

Stage 5 = Both eyes located on the left side of the head

No Stage 1 individuals were collected, probably because these smaller juveniles are not retained in the net meshes.

As part of the study, otoliths were removed from 20 randomly selected individuals within each metamorphic stage to observe changes in otolith growth during metamorphosis. Otolith diameter increased geometrically with developmental stage, and the mean otolith diameters of the different metamorphic stages differed significantly in both sanddab species. In contrast, standard length increased asymptotically with metamorphic development in both species, and the mean standard lengths of the three later metamorphic stages did not differ significantly. In addition, size at metamorphosis was highly variable within each sanddab species. Therefore, metamorphic stage was used in the analysis of distributional patterns instead of standard length.

Depth-stratified trawls were conducted at certain sampling stations at depths of 10, 30, and 100 m. Analysis of these depth-stratified trawls indicated that earlier stages of both sanddab species were most abundant at the shallower trawl depths, while later stages were most abundant at the deeper trawl depths. The deeper distribution of later-stage pelagic juveniles might have been due to decreased buoyancy as a result of the increase in otolith size and the ossification of bony structures that occurs during metamorphosis. A behavioral response in preparation for settlement to the benthic environment could also have accounted for the deeper distribution of later stage individuals. In addition, the pelagic juveniles of the deeper-living Pacific sanddab were more abundant at the 100 m trawl depth than were the shallower living speckled sanddabs, which were most abundant at the 30 m trawl depth, suggesting that the vertical distributions of the pelagic juveniles are related to the depth distributions of the adults.

The abundances of the different metamorphic stages of both sanddab species were correlated for all sampling stations with the exception of Stages 2 and 5, which were not correlated. Contours of abundance indicated that Stage 2 individuals of both species were most abundant offshore while Stage 5 individuals were most abundant nearshore.

Conductivity-temperature-depth data and thermosalinograph data were used to determine if oceanographic factors contributed to the observed differences in the horizontal distributions of the different metamorphic stages. Salinity at the surface and at 30 m was contoured and the abundances of Stage 2 and Stage 5 individuals were overlayed onto the salinity contours. High abundances of Stage 2 individuals occurred in the transitional areas between lower salinity oceanic water and higher salinity coastal upwelled water. High abundances of Stage 2 individuals nearshore were associated with shoreward impingements of offshore, lower salinity water. In contrast, large numbers of Stage 5 individuals occurred nearshore but were not noticeably associated with any oceanographic feature. An example of salinity contours is given in Figure 4, which shows the surface salinity contours from sweep 1 during May, 1990. The size of the symbols indicate the magnitude of abundance, with Stage 5 individuals represented by asterisks and Stage 2 individuals represented by squares.

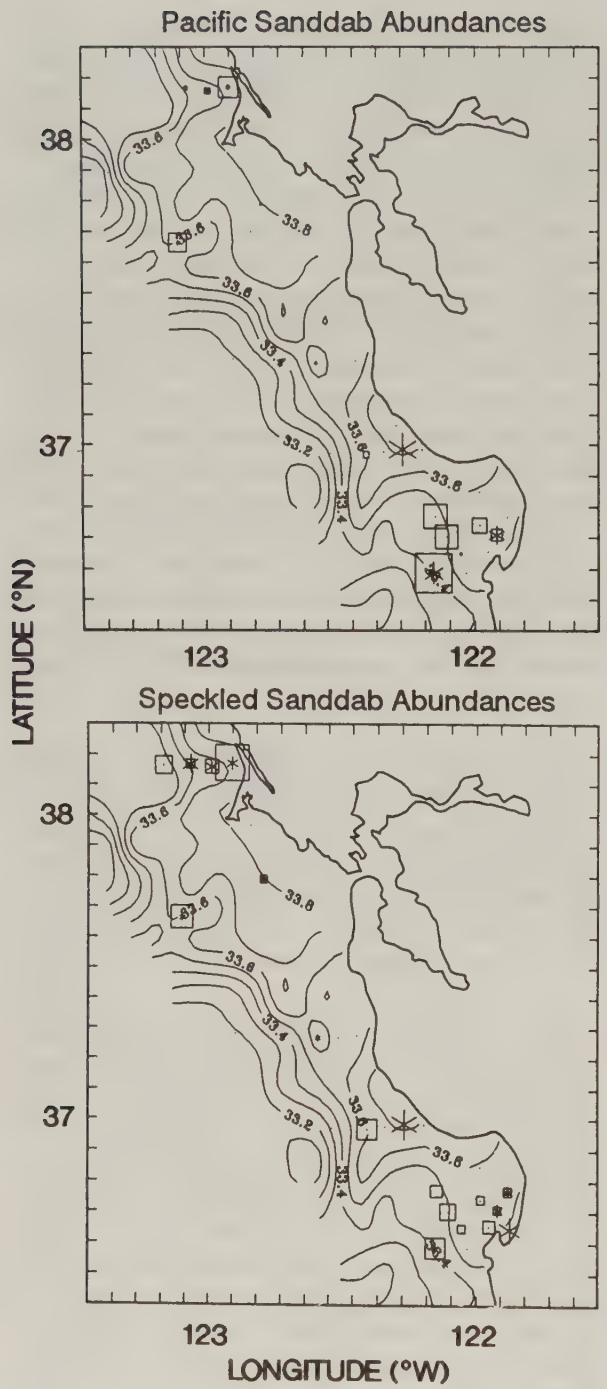

Figure 4. Surface salinity contours from sweep 1 during May 1990, with overlaid abundances of pelagic juvenile Pacific and speckled sanddabs. Asterisks represent Stage 5 abundance; squares represent Stage 2. Symbol size indicates the relative magnitude of abundance based on log-transformed indices of abundance. Minimum values are 0.7 for both species and stages, and maximum abundances are Pacific sanddab: stage 2=3.42, stage 5=3.01; speckled sanddab: stage 2=3.23, stage 5=2.71.

To determine whether the different metamorphic stages of both sanddab species were susceptible to offshore transport due to coastal upwelling, abundances from 1990 and 1991 were converted to standard scores and a series of t-tests were performed, comparing abundance in upwelling and non-upwelling areas. Upwelling areas were defined as those areas having surface salinities greater than 33.6 ppt and surface temperatures less than 11 °C. The results indicated that earlier stages of both sanddab species were significantly less abundant in areas of upwelling while later stages showed a non-significant trend for increased abundance in upwelling areas. The results also indicated that earlier stages were susceptible to offshore transport due to upwelling but that later stages were able to reach nearshore settlement areas regardless of upwelling. (K. Sakuma, [415] 435-3149)

GROUNDFISH PHYSIOLOGICAL ECOLOGY INVESTIGATION

Developmental Rates Determined During Gestation of Embryos and Larvae in Viviparous Yellowtail Rockfish, *Sebastes flavidus*

Yellowtail rockfish is an important rockfish species of both the recreational and commercial fisheries from northern California to British Columbia, Canada. However, increasing exploitation over the past 15 years has caused significant declines in abundances of stocks.

The *Sebastes* species, including the yellowtail rockfish, share a unique reproductive life history: their annual reproductive cycle includes internal fertilization, sperm storage, ovarian incubation of embryos and larvae, and varying degrees of viviparity. One of the problems facing researchers attempting to estimate spawning biomass of rockfishes by the larval production technique is the lack of information on the time required for embryonic and larval development, which is needed to estimate parturition dates. Biologists conducted laboratory experiments to determine these developmental rates for gestating female yellowtail rockfish during the 1990/91 and 1991/92 reproductive seasons (November to March). The work was conducted at the University of California's Bodega Marine Laboratory.

Twenty previously inseminated adult yellowtail rockfish were collected by hook-and-line at the Cordell Bank seamount, approximately 37 km from the coast, and transported live to 2000-L laboratory

tanks. Fish were maintained at ambient water temperatures (range = 10.3-14.1 °C.) and photoperiods. Oocytes were subsampled weekly by catheterization of anesthetized fish until fertilization was observed. After fertilization, developing embryos and larvae were subsampled at 1- to 4-day intervals until parturition. Staging was done with light microscopy of live specimens.

Table 1. Sequence and time course of development for laboratory-held embryos and larvae to determine developmental rates for gestating female yellowtail rockfish (during the 1990/91 and 1991/92 reproductive seasons), and time spans (in days) estimated for the duration of significant developmental periods. SD equals standard deviation.

Developmental Stage	Days Post-Fertilization
Newly fertilized oocyte	0
Germ disc formation	
Early cell cleavage	
Morula	3
Blastula	
Epiboly (see Fig. 5)	
Gastrula	5
Embryonic shield	
Headfold formation	7
Optic vesicle	
Somite formation	
Optic cups/auditory vesicle	11
Otolith formation	
Retina pigmentation	18
Blood circulation; mouth and anus open	21
Yolk depletion	
Hatching	23
Yolk and oil globule depletion	
Parturition (see Fig. 6)	29

Developmental Period	Mean	SD	Range
Fertilization to hatching	22.7	1.2	21-24
Hatching to parturition	6.2	1.8	4-10
Fertilization to parturition	28.9	2.4	27-33

On June 14-16, 1992, Fishery Biologist Mickey Eldridge presented a poster describing embryonic and larval development in yellowtail rockfish at the 16th Annual Larval Fish Conference, University of Rhode Island, Kingston, Rhode Island (M. Eldridge, [415] 435-3149)

Figure 5. Embryonic shield of a yellowtail rockfish in the midst of epiboly.

Figure 6. Hatched larva of a yellowtail rockfish ready for parturition, with the yolk depleted and small oil globule remaining.

INFORMATION TECHNOLOGY SERVICES

AIMS Project Progresses

The Administrative Information Management System (AIMS) is a long-range computer project under development by Information Technology Services (ITS). The objective is to set up computer systems to meet the needs of the Southwest Region/Southwest Fisheries Science Center (SWFSC) users. The modular structure of AIMS allows for phased implementation of the information catego-

ries according to a priority schedule set by SWFSC users.

The five major modules making up the AIMS are the financial reporting system (FRS) and the personnel support, management support, administrative support, and research support modules. Each module contains one or more categories. A category is a task-oriented function such as tracking SWFSC personal property items or producing purchase orders.

The FRS is now accessible by any SWFSC employee. Password security and multi-user capabilities have been implemented. New user documentation and training have been provided and many users are routinely accessing the FRS reporting capabilities.

For instance, for one category of the FRS, procedures have been programmed which work with the Small Purchasing System and the Imprest Fund Voucher System and are used by Bobbi Watkins, program support assistant, and Ron Whyte, time and leave clerk, respectively, to extract data from these systems and transparently input them into the FRS data base. This eliminates redundant manual data entry by the FRS administrators.

Another Category of the FRS, the new SWFSC Personal Property System, is operating on the La Jolla LAN using FoxPro 2.0. Program Support Specialist Barbara Engstrand is the initial user of the system. The system will provide SWFSC staff with fast and flexible centralized control of accountable inventory. The personal property data base was created by downloading property data from the National Finance Center's (NFC) master property data base. The data base will be updated by processing quarterly property data downloads from the NFC data base.

A third category of the FRS, a commercial software package called Envelope Manager has also been installed on the SWFSC LAN. The main purpose of the system is to maintain mailing lists for organizational mailings. Envelope Manager is a PC DOS-based mailing label management system that allows users to create professional mailing labels, envelopes, address fliers, and business reply mail. Envelope Manager includes features such as POSTNET Bar Coding, United States Postal Service facing identification marking, ZIP+4 look up, ZIP+4 batch sorting, and label format standardization. Most of the mailing data bases in the La Jolla Laboratory have been converted to run with Envelope Manager. Due to the availability to LANS users, the ease of use, and the quality of output, several new mailing lists have been generated. The Envelope Manager software is available to anyone with access to the La Jolla LAN.

The design and prototyping of the SWFSC Personnel System is under way. The prototype has been developed using a set of SWFSC personnel data downloaded from the NFC's Sperry computer and the Oracle data base management system (DBMS) software. Several meetings with Virginia Hostler, Equal Employment Opportunity specialist, have taken place and the initial design of the computer screen forms and the output reports have been prepared. The Oracle software was selected for the personnel system for several reasons: (1) Oracle is the NOAA standard DBMS, (2) the tools and capabilities of the Oracle DBMS suit the development of a personnel system, and (3) it will give the ITS staff a chance to evaluate Oracle for use in future applications.

Information has been obtained from the Western Administrative Support Center (WASC) regarding their efforts to automate travel order tasks and training request tasks. Travel order automation information, prototype forms, and data bases have been received from a computer programmer/analyst at WASC for our evaluation. ITS is awaiting information on the automated training request system.

The plan is to continue working on categories in the AIMS modules in order of priority. The approach is to use and re-use existing systems and tailor existing systems and data to fit our organization's requirements and to totally develop new systems if the available systems do not fit our needs.

Since it is intended that AIMS will support staff at all SWFSC locations, beginning in FY 93, an emphasis will be placed on opening the communication channels with the remote SWFSC Laboratories, such as Honolulu, Tiburon, the Pacific Environmental Group in Monterey, and with the Southwest Regional Office, to implement the AIMS categories. The purchase of software, the transfer of applications, and the remote system support must be set up. Most of the work and testing has been done locally. As the systems are proven to operate correctly, they will be distributed. (R. Bistodeau, [619] 546-7055)

PUBLICATIONS

Published

Barlow, J. 1992. Nonlinear and logistic growth in experimental populations of guppies. Ecology 73(3):941-950.

Previous experiments have shown that for a specific experimental system of guppies, *Poecilia reticulata*, per capita growth rate is linearly related to population biomass. A length-specific population model is developed to examine how the various mechanisms of density dependence (i.e., changes in somatic growth rates, reproductive rates, and cannibalism) act in concert to shape the overall population response to intraspecific competition. Despite many nonlinear components, equilibrium per capita growth in the model is linearly related to population biomass, mimicking the logistic growth seen in the experiment. Using the model, the components of density dependence are varied to determine how each component shapes the overall density-dependent response. Density dependence in somatic growth rates is found to be the most important population-regulating mechanism in this system. In the past, emphasis has been placed on density dependence in birth and death functions. The importance of somatic growth in shaping per capita population growth curves may be underestimated.

Boehlert, G. W., W. Watson, and C. L. Sun. 1992. Horizontal and vertical distribution of larval fishes around an isolated oceanic island in the tropical Pacific. Deep-Sea Res. (39)3/4:439-466.

Ichthyoplankton and oceanographic sampling was conducted in November 1984 in waters surrounding Johnston Atoll (16°44′ N, 169°32′ W), a small, isolated atoll in the central Pacific Ocean. The typical flow pattern in this region is westward; the nearest island is in the Hawaiian Archipelago, 760 km away.

Most collections were dominated by oceanic taxa. In the 0-50 m stratum, larval densities were relatively uniform horizontally, but densities downcurrent of the island tended to be higher, and fish eggs were concentrated there. In the 50-100 m stratum, larval abundance on the down-current side of the island was markedly higher than either up current or farther down current. Oceanic taxa did not display this pattern, while marked areas of very high abundance characterized the island-related taxa, the most abundant including the gobiid, *Eviota epiphanes*, and the apogonid, *Pseudamiops* sp. Estimates of geostrophic flow indicate that the region down current of the atoll was one of return flow associated with apparent mesoscale eddies or meanders north and west of the island. This region may serve as a down-current retention area for the pelagic larvae of island-related taxa and may facilitate recruitment back to the source populations.

Everson, A. R., R. A. Skillman, and J. J. Polovina. 1992. Evaluation of rectangular and circular escape vents in the Northwestern Hawaiian Islands lobster fishery. N. Am. J. Fish. Manage. 12:161-171.

Research was conducted in Hawaii during 1984-1987 to investigate the possibility that escape vents fitted in traps used by the commercial lobster fishery in the Northwestern Hawaiian Islands would reduce the catch and mortality of sublegal spiny lobsters, *Panulirus marginatus* (<50 mm tail width), and slipper lobsters, *Scyllarides* spp. (<56 mm tail width), without significantly reducing legal catch. A circular vent was more efficient than the traditional rectangular vent in maximizing escapement of sublegal lobsters and retention of legal ones for both species. Optimum results were attained with two vented panels each containing four 67-mm-diameter circular vents. Traps equipped with the circular panels caught 83 percent fewer sublegal spiny lobsters and 93 percent fewer sublegal slipper lobsters than nonvented control traps, and they did not significantly reduce legal catch of either species. In contrast, traps with two 49-mm-high x 285-mm-wide rectangular vents reduced the catch of sublegal spiny and slipper lobsters by 70 and 93 percent, respectively, but also reduced legal slipper lobster retention by a significant 32 percent of the catch. As a result of this research, all traps used in the lobster fishery in the Northwestern Hawaiian Islands after January 1, 1988, must be equipped with two panels with 67-mm circular vents. The 1988 catch of sublegal spiny lobsters declined by 38 percent at Necker Island, Northwestern Hawaiian Islands, whereas the legal catch increased substantially.

Fiedler, P. C., V. Philbrick, and F. P. Chavez. 1991. Oceanic upwelling and productivity in the eastern tropical Pacific. Limnol. Oceanogr. 36(8):1834-1850.

An oceanographic survey of the eastern tropical Pacific Ocean in August-November 1990 found a productive, nutrient-rich, moderately high-chlorophyll surface layer in two oceanic upwelling regions: the equatorial divergence, especially east of the Galapagos, and the countercurrent divergence out to 105° W, >1,000 km west of the Costa Rica Dome. Although NO_3 is not depleted in upwelling regions, relationships among nutrient concentrations and temperature in 1986-1988 data from the same area show that NO_3 is the first macronutrient to be depleted in adjacent, less-productive regions. A three-dimensional, two-layer box model of NO_3 flux within and into the euphotic zone gives estimated rates of new production that are ~29 percent of measured rates of ^{14}C phytoplankton production. Persistence of excess (saturating) NO_3 in the euphotic zone exceeds 1 year under high-nutrient, low-chlorophyll conditions off the equator where weak upwelling, or downwelling, occurs. These results indicate substantial control or limitation of NO_3 utilization and productivity in nutrient-rich oceanic regions of the eastern tropical Pacific.

Hunter, J. R., F. J. Macewicz, N. C. Lo, and C. A. Kimbrell. 1992. Fecundity, spawning, and maturity of female Dover sole, *Microstomus pacificus*, with an evaluation of assumptions and precision. Fish. Bull., U.S. 90:101-128.

The potential annual fecundity of Dover sole becomes fixed before the spawning season when the average diameter of the advanced stock of yolked oocytes exceeds 0.86 mm; hence potential annual fecundity is determinate. More central California females had atretic advanced oocytes than Oregon females, but rates of atresia advanced sufficiently to have an important effect on the potential annual fecundity of the population. A 1-kg female matured about 83,000 advanced yolked oocytes at the beginning of the season. Vitellogenesis continued for the advanced yolked oocytes during most of the spawning season while batches were repetitively matured and spawned. About nine batches were spawned over a 6-month spawning season (December-May), and spawning ceased when the standing stock of advanced oocytes was exhausted. A 1-kg female released about 10,000 eggs per spawning, except for the first and last batches which were smaller than the rest. Near the end of the season, females may spawn more frequently than earlier in the year, increasing the daily production of eggs by the population even though fewer females are reproductively active. Annual reproductive effort of Dover sole was equivalent to about 14 percent of body wet weight per year. Fifty percent of the females had become sexually mature when they reached 332 mm total length.

Various methodological issues were also treated in this paper, including validation of key assumptions underlying estimates of annual fecundity; fecundity sample-size requirements; evaluation of criteria and bias in estimating female sexual maturity; and comparisons of classification by histology and gross anatomy.

Stepien, C. A. 1992. Evolution and biogeography of the Clinidae (Teleostei: Blennioidei). Copeia 2:375-392.

The systematic and biogeographic relationships of the teleost family Clinidae (commonly known as kelpfishes or klipfishes), an antitropically distributed group of nearshore fishes characterized by widespread ecological variation, were analyzed using allozyme and morphological characters. The Clinidae comprises three tribes; the matritrophic (ovoviviparous) Clinini and Ophiclinini, and the oviparous tribe Myxodini. Emphasis of the present study was in resolving the relationships among the eastern Pacific Myxodini, which include the South American genus *Myxodes* and the North American genera *Heterostichus* and *Gibbonisa*. Allozyme data were analyzed from 40 presumptive gene loci for all four North American myxodin species, one species of the Australian clinid tribe Clinini, *Heteroclinus whiteleggei*, 10 species (representing all tribes) of the hypothesized sister Blennioid family, the Labrisomidae, and two species of the Blennioid family Chaenopsidae (also believed to be closely related, the latter two families were used as outgroups).

Several different phylogenetic approaches for analyzing allozyme data were used for purposes of comparison, including two frequency character methods, a genetic distance method, a discrete character parsimony method (using only fixed alleles), and a multistate character parsimony analysis (the latter two used presumptive gene loci as characters and selected alleles as character states). Discrete morphological characters were also analyzed both separately and included with allozyme data in parsimony analyses.

Results from morphological and allozyme data, as well as the different methods of phylogenetic analysis, were congruent; yielding identical parsimonious relationships among taxa, except within the genus *Gibbonsia*. Two most parsimonious trees were consistently obtained, which differ in whether *G. metzi* or *G. elegans* is the basal clade within the genus (and the sister group to the other two species). The Clinidae is distinguished by a suite of allozyme character state synapomorphies identified in the present study as well as three morphological synapomorphies. The present study indicates that the cryptotremin labrisomids are the sister group to the Clinidae. The trophodermic matritrophic (ovoviviparous) clinids (comprising the tribes Clinini and Ophiclinini) and the Myxodini are sister taxa, and the South American myxodin genus *Myxodes* is sister to the northern myxodin genera. The North American genera *Heterostichus* and *Gibbonsia* are sister groups.

Ueber, E., and A. D. MacCall. 1992. The rise and fall of the California sardine empire. p. 31-48. *In* Glantz, Michael (ed.), Climate variability, climate change and fisheries. Cambridge University Press, Cambridge, England.

The development and collapse of the California sardine fishery and the subsequent effects on international fishery development provide numerous lessons that anticipate likely future societal effects of global climate change. Decline of a major fishery may lead to development of substitute domestic fisheries or to international transfer of industrial capacity. In both cases, fishery development will occur extraordinarily rapidly due to pre-existing equipment, expertise and markets. The political process of establishing management institutions and the scientific process of developing predictive fishery models are much slower than industrial development of substitute fisheries. Because both the old fisheries and new substitute fisheries may be inherently unstable due to climate change, we expect that, under global climate change, this rapid transfer of harvesting and processing capacity combined with delayed and inadequate management will exacerbate instability of fisheries throughout the world.

Approved by Science and Research Director, SWR

Balazs, G. H., P. Siu, and J. Landret. Ecological aspects of green turtles nesting at Scilly Atoll in French Polynesia. For consideration for publication in Proceedings of the 1992 Sea Turtle Symposium.

Brill, R. W., and D. B. Holts. Effects of entanglement in high-seas driftnets on the relative fitness of North Pacific albacore, *Thunnus alalunga*, recaptured by troll gear. For consideration for publication in *Fishery Bulletin, U.S.*

Davenport, J., G. H. Balazs, J. W. Faithfull, and D. A. Williamson. A struvite faecolith in the leatherback turtle, *Dermochelys coriacea*, vandelli. For consideration for publication in *Journal of Herpetology.*

DeMartini, E. E. Modeling the potential of fishery reserves for managing Pacific coral reef fishes. For consideration for publication in *Fishery Bulletin, U.S.*

Haight, W. R., J. D. Parrish, and T. A. Hayes. Feeding ecology of deepwater lutjanid snappers at Penguin Bank, Hawaii: depth, time of day, diet, and temporal changes. For consideration for publication in *Transactions of the American Fisheries Society.*

Holland, K., R. Brill, R. Chang, J. Sibert, and D. Fournier. Physiological and behavioral thermoregulation in bigeye tuna. For consideration for publication in *Science.*

Humphreys, Jr., R. L., M. A. Crossler, and C. M. Rowland. Use of a monogenean gill parasite and feasibility of condition indices for identifying new recruits to a seamount population of armorhead, *Pseudopentaceros wheeleri* (Pentacerotidae). For consideration for publication in *Fishery Bulletin, U.S.*

Laidig, T. E., and D. E. Pearson. Documentation of three computer programs used to assess daily age from the hard structures of animals. For consideration for publication in NOAA Technical Report Series.

MacCall, A. D. Advice for stock rebuilding. For consideration for publication *In* A. Rosenberg (ed.), Technical Report NMFS.

Perrin, W.F., and J. E. Heyning. Rostral fusion as a criterion of cranial maturity in the common dolphin, *Delphinus delphis.* For consideration for publication in *Marine Mammal Science.*

Perryman, W., and M. Lynn. Identification of geographic forms of common dolphins from aerial photographs. For consideration for publication in *Marine Mammal Science.*

Prager, M. H., and A. D. MacCall. Detection of contaminant and climate effects on spawning success of three pelagic fish stocks off southern California: Northern anchovy, *Engraulis mordax*, Pacific sardine, *Sardinops sagax*, and chub mackerel, *Scomber japonicus*. For consideration for publication in *Fishery Bulletin, U.S.*

Rosel, P. E., M. G. Haygood, and W. F. Perrin. Relationships among the porpoises (Cetacea: Phocoenidae), inferred from mitochondrial DNA sequences. For consideration for publication in *Molecular Biology and Evolution.*

Squire, Jr., J. L. Effects of the Santa Barbara, California, oil spill on the apparent abundance of the pelagic fishery resources. For consideration for publication in *Marine Fisheries Review.*

Administrative Reports

Administrative Reports are strictly for internal use only and are not to be cited or treated as publications.

La Jolla

DeMaster, D. P. 1992. Strategic plan to develop and evaluate "dolphin-safe" methods of fishing for yellowfin tuna in the eastern tropical Pacific: goals and objectives. SWFSC Admin. Rep., La Jolla, LJ-92-16, 34 p.

Hewitt, R. P., and J. E. Rosenberg (eds). 1992. AMLR 1991/92 field season report: objectives, accomplishments, and tentative conclusions. SWFSC Admin. Rep., La Jolla, LJ-92-17, 116 p.

Schwartz, M. L., A. A. Hohn, H. J. Bernard, S. J. Chivers, and K. M. Peltier. 1992. Stomach contents of beachcast cetaceans collected along the San Diego County coast of California, 1972-1991. SWFSC Admin. Rep., La Jolla, LJ-92-18, 33 p.

Lowry M. L., and W. L. Perryman. 1992. Aerial photographic census of California Sea Lion, *Zalophus californianus*, pups at San Miguel Island, California, for 1987-1990 and San Nicolas Island, California, 1990. SWFSC Admin. Rep., La Jolla, LJ-92-19, 19 p.

Lowry, M. L., and W. L. Perryman. 1992. Using large format vertical aerial photography to census northern elephant seals, *Mirounga angustirostris*, at San Miguel, San Nicolas, and Santa Rosa Islands, California. SWFSC Admin. Rep., La Jolla, LJ-92-20, 31 p.

DeMaster, D. P., and J. E. Sisson. 1992. Minutes from a workshop on status of porpoise stocks in the eastern tropical Pacific, with special emphasis on the period 1985-1990. SWFSC Admin. Rep., La Jolla, LJ-92-21, 67 p.

Lee, J. G. 1992. Regulation of open-access fisheries: an examination of the west coast groundfish fishery. SWFSC Admin. Rep., La Jolla, LJ-92-22.

Herrick Jr., S., J. G. Lee, and D. Squires. 1992. Documentation for the west coast fishing fleet cost-earnings data base. SWFSC Admin. Rep., La Jolla, LJ-92-23, 32 p.

Jacobson, L. D., and N. C. H. Lo. 1992. Spawning of the northern anchovy in 1992. SWFSC Admin. Rep., La Jolla, LJ-92-24, 69 p.

Thomson C., G. Walls, and J. Morgan. 1992. Status of the California Coastal Pelagic Fisheries in 1991. SWFSC Admin. Rep., La Jolla, LJ-92-25, 47 p.

Eber, L. E. 1992. NOAA/NOS bathymetric digitization program RUNBATHY. SWFSC Admin. Rep., La Jolla, LJ-92-26, 12 p.

Eber, L. E. 1992. CalCOFI oceanographic data retrieval program RUNCCOFI. SWFSC Admin. Rep., La Jolla, LJ-92-27, 13 p.

Hill, P. S., and T. Gerrodette. 1992. Evaluation of the CAST system during three years of operation. SWFSC Admin. Rep., La Jolla, LJ-92-28, 22 p.

Honolulu

Skillman, R. A., and G. L. Kamer. 1992. A correlation analysis of Hawaii and foreign fishery statistics for billfishes, mahimahi, wahoo, and pelagic sharks, 1962-78. SWFSC Admin. Rep., Honolulu, H-92-05, 33 p.

Hamm, D. C., R. S. Antonio, and M. M. C. Quach. 1992. Fishery statistics of the western Pacific, Volume VII. SWFSC Admin. Rep., Honolulu, H-92-06, 239 p.

Aguirre, A. A. 1992. Occurrence of potential pathogens in green sea turtles, *Chelonia mydas*, afflicted or free of fibropapillomas in Kaneohe Bay, Island of Oahu, Hawaii, 1991. SWFSC Admin. Rep., Honolulu, H-92-07, 18 p.

Hamm, D. C., and H. K. Lum. 1992. Preliminary results of the Hawaii small-boat fisheries survey. SWFSC Admin. Rep., Honolulu, H-92-08, 35 p.

Tiburon

Staff of the Tiburon Laboratory. 1991. Progress in rockfish recruitment studies. Adams, P. B. (ed.). SWFSC Admin. Rep., Tiburon, T-92-01, 63 p.

UNITED STATES
DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST FISHERIES SCIENCE CENTER
8604 LA JOLLA SHORES DRIVE
P.O. BOX 271
LA JOLLA, CALIFORNIA 92038-0271

OFFICIAL BUSINESS
PENALITY FOR PRIVATE USE, $300

THIRD CLASS